

**STANDARD SPECIFICATIONS
FOR
HIGHWAY AND BRIDGE
CONSTRUCTION**

NEW MEXICO
DEPARTMENT
OF
TRANSPORTATION

2019 EDITION

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SECTION 101: ABBREVIATIONS, SYMBOLS, TERMS, AND DEFINITIONS

101.1 ACTIVE VOICE, IMPERATIVE MOOD, REFERENCES, USE OF LANGUAGE

The New Mexico Department of Transportation publishes this edition of the Standard Specifications for Highway and Bridge Construction with an emphasis on the active voice. In a sentence written in the active voice, someone acts on something. For example: "The Engineer will take a sample." A similar sentence in the passive voice "A sample will be taken" would be unclear about who was responsible for taking the sample.

This edition of the Standard Specifications also makes use of the imperative mood. The imperative mood is used when the party issuing an instruction and the party receiving it are already understood. In these Standard Specifications, the Department is stating its requirements or directions for Work to the Contractor; such statements have the same force as if they contained the word "shall." In an imperative sentence such as, "Pour the concrete," the Department is indicating that it requires the Contractor to pour the concrete. Before an Award of a Contract, imperative statements are directed to the Bidder. After a Contract has been awarded, imperatives are directed to the Contractor. The Standard Specifications are divided into various parts in this order: divisions, sections and subsections.

The Department will identify parties other than the Bidder or Contractor to whom it gives a responsibility in these Standard Specifications. In phrasings where the responsible party has already been clearly identified or in factual statements when it is not important to do so, the Department may use the passive voice.

The word "shall" is used in a mandatory or imperative sense and signifies that the Department is imposing a duty on a person or body that is the subject in the sentence. The word "may" is used to signify the conferring of a discretionary power, privilege, or right. However, use of the term "may not" signifies that a right, privilege, or power is intended to be denied.

The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

The Contractor, having an obligation to comply with, observe, and comply with all federal and State law and regulations, any reference to any federal or State law or regulation shall constitute a reference to any applicable amendment or successor law or regulation.

101.2 ABBREVIATIONS

When the following abbreviations are used in the Plans, the Specifications, other Contract documents, and Department correspondence, their meaning is as follows:

Table 101.2:1 Acronyms and Abbreviations	
Acronym or short form	Full name or meaning
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AI	Aggregate Index
AMRL	AASHTO Material Reference Laboratory

**Table 101.2:1
Acronyms and Abbreviations**

Acronym or short form	Full name or meaning
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWPA	American Wood Preservers' Association
AWWA	American Water Works Association
CBC	concrete box culvert
CCD	closed circuit detection
CD	compact disc
CFR	Code of Federal Regulations
CMP	corrugated metal pipe
CN	control number
CPM	Critical Path Method
CTR	certified test report
CWB	concrete wall barrier
DBE	disadvantaged business enterprise
EA	entrance angle
ESAL	equivalent single axle loading
FHWA	Federal Highway Administration
GRT	gross receipt tax
HDPE	high density polyethylene
HFE	high-float emulsion
HID	high-intensity discharge
HMA	hot-mix asphalt
HMWM	high molecular weight methacrylate
IES	Illuminating Engineering Society
IMC	intermediate metallic conduit
ITE	Institute of Transportation Engineers
JMF	job mix formula
LCD	liquid crystal display
LL	liquid limit
SDS	Safety Data Sheet
MTR	mill test report
MUTCD	Manual on Uniform Traffic Control Devices
MFBM	Thousand Board Feet
NCHRP	National Cooperative Highway Research Program
NEC®	National Electrical Code®
NEMA	National Electrical Manufacturers Association
NMAC	New Mexico Administrative Code
NMDA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMSSPWC	New Mexico Standard Specifications for Public Works Construction
NPDES	National Pollutant Discharge Elimination System
NTSC	National Transmission Standards Committee
OA	observation angle
OGFC	open-graded friction course
OSHA	Occupational Safety and Health Administration
PCC	portland cement concrete
PCCP	portland cement concrete pavement

Table 101.2:1 Acronyms and Abbreviations	
Acronym or short form	Full name or meaning
PCI	Prestressed Concrete Institute
PCT	process control technician
PE-P	penetrating emulsified prime
PI	plasticity index
PTL	private testing laboratory
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QCT	quality control technician
QLA	quality level assurance
RAP	reclaimed asphalt pavement
ROW	right of way
SSPC	Society of Protective Coating (formerly Steel Structures Painting Council)
SWPPP	storm water pollution prevention plan
TERO	Tribal Employment Rights Organization
TTCP	Technician Training and Certification Program
TV	target value
UBC™	Uniform Building Code™
UL	Underwriters Laboratories
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VMA	voids in mineral aggregate
VTM	voids in total mix
WMA	warm mix asphalt

101.3 SYMBOLS

Within the Specifications and Contract, reference to the English system of measurement symbols is a reference to the U.S. Customary (Inch-pound) system.

Some of the symbols for units of measurement used in the Specifications and in the Bid Schedule are defined as shown in Table 101.3:1, "Measurement Symbols." The symbols for other units of measurement used in the Specifications are as defined in the various Specifications and tests referenced in the Specifications.

Table 101.3:1 Measurement Symbols		
Physical Characteristic	Unit name	Symbol
Length	Microinch	μin
	mil (0.001 inch)	Mil
	Inch	In
	Foot	Ft
	Yard	Yd
	Mile	Mi
Area	square inch	in ²

**Table 101.3:1
Measurement Symbols**

Physical Characteristic	Unit name	Symbol
	square foot	ft ²
	square yard	yd ²
	square mile	mi ²
	Acre	Acre
Volume	Pint	Pt
	Quart	Qt
	Gallon	Gal
	cubic inch	in ³
	cubic foot	ft ³
	cubic yard	yd ³
Mass (weight)	Ounce	Oz
	Pound	Lb
	ton, short (2,000 lb)	Ton
Temperature	degree Fahrenheit	°F
Time	Millisecond	Ms
	Second	S
	Minute	Min
	Hour	H
Speed	miles per hour	Mph
Pressure	pound-force per square inch	Psi
Power, energy and electricity	Watt	W
	Kilowatt	kW
	Milliampere	mA
	Ampere	A
	Volt	V
	Volt-ampere	VA
	Ohm	Ω
	Hertz	Hz
	Joule	J
	Lumen	Lm
	Footcandle	Fc
Horsepower	Hp	
Force	pound-force	Lbf
	1,000 pounds-force	Kip
Torque	pound-force foot	lbf•ft
Viscosity, dynamic	Centipoises	cP
	Poise	P
Viscosity, kinematic	Centistokes	cSt

**Table 101.3:1
Measurement Symbols**

Physical Characteristic	Unit name	Symbol
Flow	gallons per minute	Gpm
Concentration	parts per million	Ppm
Inductance	Henries	H
Frequency, concrete consolidation	vibrations per minute	Vpm
Sound	Decibel, A-Scale	dbA

101.3.1 Engineer's Estimate Symbols

The measurement symbols shown on the Engineer's Estimate may differ from those found in the rest of Contract documents. Table 101.3.1:1, "Symbols for Engineer's Estimate," lists and defines the symbols found in both the Engineer's Estimate and Contract documents.

**Table 101.3.1:1
Symbols for Engineer's Estimate**

Symbol	Unit of measure or meaning
LS	Lump Sum
EACH	Each
ALOW	Allowance
L.F.	Linear Foot
MILE	Mile
S.F.	Square Foot
S.Y.	Square Yard
SYIN	Square Yard Inch
ACRE	Acr
C.Y.	Cubic Yard
LB	Pound
TON	Ton

101.4 TERMS AND DEFINITIONS

If the following terms are used in the Contract documents, and **Department** correspondence, the intent and meaning shall be interpreted as follows:

Acceptance. (Also called **Accept**, **Accepted** and **Acceptable**) 1) The determination by the **Department** that Materials and Work are in compliance with the Contract. 2) The process by which the **Department** determines whether or not the quality of produced Material or Work is **Acceptable** pursuant to the Contract, including sampling, testing, certifications and assessment of test results. Acceptance shall not be construed as a warranty by the Department that the Contractor's methods will succeed or will be the most efficient or economical method of accomplishing the Work, nor shall the term be construed that the actual Materials used in construction will perform as represented in test results supplied to the Department by the Contractor.

Addendum. A change in the Contract issued after the **Advertisement** and before the Bid Opening.

Advertisement. A public announcement, as required by law, inviting **Bids** for **Work** to be performed or **Materials** to be provided. Also called Invitation for Bids.

Apparent Low Bidder. The **Bidder** who submits a **Total Bid Amount** that is numerically lower than the **Total Bid Amount** submitted by other **Bidders**, but who's **Bid** may later be subject to rejection, recalculation or other modification that may change the order of **Bidders**.

Assistant District Engineer (ADE) - Construction. The **Engineer** in charge of the construction operations in a **District**.

Award. The Department's selection of a Bidder's Bid subject to the Contractor's and Department's execution of the Contract.

Base Course. The layer or layers of specified **Material** placed on a **Subbase** or a **Subgrade** normally used to support a **Surface Course**.

Basis of Payment. The terms under which **Work** is paid, as a designated **Pay Item** in accordance with the quantity measured and the **Pay Unit**. Basis of Payment includes the performance of all Work and furnishing of all labor, Equipment, Materials and Incidentals described in the text of a specific item included in that Contract.

Bid. The offer of a **Bidder** for performing the **Work** at the prices quoted.

Bidder. An individual, partnership, firm, corporation, joint venture, or their authorized representative submitting a **Bid**.

Bid Form. The approved form on which the **Department** requires **Bidders** to prepare and submit **Bids**.

Bid Guaranty. The security provided with a **Bid** to guarantee that the **Bidder** will enter into the **Contract** if the **Department** Accepts its **Bid**.

Bid Item (Contract Item, Pay Item). A specifically described unit of **Work** for which a **Bidder** provides a **Bid Item Unit Price** and **Bid Item Price**. The **Bid Items** become **Contract Items** when the **Contract** is fully executed. The **Contract Items** become **Pay Items** when calculating **Progress Payments**.

Bid Item Price. The extended price established by the **Contractor** for each individual **Bid Item** on the **Bid Schedule** which is the product of the **Bid Item** quantity and the **Bid Item Unit Price**.

Bid Item Unit Price. The price established by the **Contractor** for each unit of an individual **Bid Item** on the **Bid Schedule**. A **Bid Item Unit Price** reflects a **Bidder's** actual and direct costs for the item plus a reasonable proportionate share of the **Bidder's** anticipated profit, overhead costs, and other indirect costs.

Bid Opening. A public reading of the properly submitted **Bids**, on a date established by the **Advertisement**.

Bid Schedule. Listing or table of **Bid Items** containing the estimated quantities for which **Bid Item Unit Prices** are invited.

Borrow Pit. A Contractor selected source outside the **Roadway Prism** from where suitable

Material is obtained.

Breakaway. The ability of a system to yield at a predetermined impact force.

Bridge. A **Structure** having a length — as measured along the center of the **Roadway** — of more than 20 ft between undercopings of abutments or extreme ends of openings for multiple boxes or extreme ends of openings for Culverts placed in series with a spacing between Culverts not exceeding ½ the diameter, and carrying a pathway or **Roadway** over a depression or obstacle. It includes all appurtenances necessary to its proper use. The length of a **Bridge** structure is the distance along the line of survey stationing back-to-back of backwalls of abutments, if present, or end-to-end of the **Bridge** floor, and in no case less than the total clear opening of the structure. The **Bridge Roadway** width is that clear unobstructed width of **Bridge** deck available for vehicle use measured normal to the centerline of the **Bridge**.

Business Hours. The **Department's** Business Hours are from 7:45 a.m. to 4:30 p.m., Monday through Friday, official State **Holidays** and emergency closures excluded.

Cabinet Secretary. The individual in charge of the Department as defined by law. Also referred to as the "**Secretary**".

Calendar Day. Each and every **Day** shown on the calendar, beginning and ending at midnight. Also referred to as "**Day**".

Certificate of Compliance. A certification, including a signature by a person having legal authority to act for the manufacturer, stating that the product, assembly, or **Material** to be incorporated into the **Project** was fabricated in accordance with and meets the applicable terms of the **Contract**.

Change Order. A **Change Order** is the only method authorized for changing the **Contract**. A written order, with or without the consent of the Contractor, implementing the **Contract** changes. A **Change Order** may consist of a **Supplemental Agreement** or **Field Sheet**.

Chief Engineer. The **Engineer** in charge of the design of **Projects**, acting either directly or through his duly authorized representatives, for the **Department**.

Chill Factor. Is the ambient temperature (in degrees Fahrenheit) minus wind velocity (in miles per hour).

Claim. A timely **Contractor** request or demand for a **Contract** adjustment, equitable adjustment, additional time or compensation and other contractual damages, **Delay** damages, an extension of **Contract Time**, certified pass-through Subcontractor Claims, or for any other remedy arising from a dispute, disagreement, or controversy concerning respective rights and obligations under the **Contract**.

Commercial Material Source. A **Material** source that has been utilized by a private producer in a commercial operation from which **Material** has been sold within the last 24 months before the date of the letting.

Completion Dates. **Contracts** may have the following Completion Dates as defined herein:

Substantial Completion Date;

Physical Completion Date; or

Mandatory Completion Date.

Construction Maintenance Easement (CME). A real property interest in land acquired by the **Department** in conjunction with a **Highway, Street, or Road Project** to provide permanent access to private property to perform specific construction and maintenance functions.

Construction Zone. The area within the **Right of Way** from the first traffic control sign announcing the **Road Work** to the last sign announcing the end of **Road Work** within which the **Contractor** shall perform construction activities.

Contract. The entire and integrated written agreement between the **Department** and the **Contractor** setting forth the obligations of the parties, including, but not limited to, the performance of the **Work** and the **Basis of Payment**.

The Contract includes the **Advertisement**, Required Documents for Bid Submittal, **Standard Specifications**, **Supplemental Specifications**, **Special Provisions**, **Addenda**, **Notice To Contractors**, general and detailed **Plans**, **Standard Drawings**, and **Notice to Proceed** — also any **Change Orders** and agreements that are required to complete the construction of the **Work** in an **Acceptable** manner, including authorized extensions thereof, all of which constitute one (1) instrument.

Contract Bonds. The approved form of security executed by the **Contractor** and the **Contractor's Surety** or sureties. The performance bond guarantees complete execution of the **Contract** and all **Change Orders** pertaining thereto, and the payment bond guarantees payment of all legal debts pertaining to the construction of the **Project**.

Contractor. The individual, partnership, firm, corporation, or joint venture contracting with the **Department** for performance of the **Work**.

Contract Time. The time specified in the **Advertisement** for completion of the **Contract**. This time may be defined as a specified fixed date(s), Mandatory Completion Date, a given number of **Working Days**, or a given number of **Calendar Days** or a combination of the above. The Contract Time may be amended by a Supplemental Agreement to include authorized time extensions as the performance of the **Contract** requires.

County. The County in which the **Work** herein specified is to be done.

Cultural Resource. Any prehistoric or historic period artifact, site, building, structure, Material remains, or traditional use area resulting from, or associated with, human cultural activity. Historically important **Cultural Resources** are those eligible for inclusion on the National Register of Historic Places or placed on the New Mexico register of cultural properties either permanently or temporarily per NMSA 1978, Section 18-6-3 and the National Historic Preservation Act Section 106.

Cultural Resource Professional. An individual that is permitted to meet the requirements of the Cultural Properties Act, NMSA 1978, 18-6-1 through -17 and issued by the Cultural Properties Review committee with the concurrence of the State Archaeologist and the State historic preservation officer or appropriate tribal preservation officer, or federal land managing agency when applicable.

Culvert. Any **Structure** not classified as **Bridge** or casing that provides an opening under a

Roadway.

Critical Path. The longest continuous sequence of activities through the Project schedule that establishes the minimum overall Project duration to Substantial Completion.

Critical Path Method Schedule. A network based method to represent the Contractor's plan for constructing the Project. The Critical Path Method Schedule consists of two primary components 1) Activities that represent the entire Project scope of Work and 2) logic relationships that connect the activities to one another to determine the sequence of Work.

Day. Calendar Day.

Delay. Any event, action, force or factor that negatively impacts the Critical Path on the **Project**, whether it be excusable, inexcusable, non-excusable, concurrent, compensable or non-compensable.

Deleterious Material. Unacceptable Material detrimental to the final product.

Department. The New Mexico Department of Transportation as constituted under the laws of the State for the administration of transportation Work. Any reference to **Contract** documents, **Plans, Special Provisions, Standard Drawings, Forms, Change Orders**, and any other pertinent written communication in which the terms "New Mexico State Highway Department" or "New Mexico State Highway and Transportation Department" appears shall be the same as the term New Mexico Department of Transportation or its designated agent.

Detour. A temporary route for traffic (vehicular or otherwise) around a closed portion of a **Project**.

District. A subdivision of the **State** for the purpose of executing the **Department's** construction, maintenance, and administrative activities.

District Engineer. The **Engineer** in charge of a **Department District**.

Embankment. The portion of a **Roadway** that is below the **Subbase, Base Course, and Surface Courses** and that is built up in layers consisting principally of soil and broken rock or a combination thereof.

Engineer. A Department "Engineer" authorized as the Department's representative responsible for the engineering supervision of the Work and who is qualified and licensed by the board to practice engineering per the Engineering and Surveying Practice Act.

Entrance Angle (EA). The angle between the reference axis and the axis of incident light (Counter-clockwise rotation of the reference axis relative to the axis of incident light is considered positive.)

Environmental Professional. An individual qualified to perform hazardous material investigations. This individual must possess the qualifications described in 40 C.F.R. Section 312 Subpart C, the USEPA's Standards and Practices for All Appropriate Inquiries.

Environmental Bureau Manager. The individual in charge of the Environmental Bureau of the **Department**.

Environmental Geology Bureau Manager. The individual in charge of the Environmental Geology Bureau of the **Department**.

Environmental Resource. The physical and biological components of the human and natural environment.

Environmental Specialist. An individual with at least four (4) years of full-time paid experience in environmental investigations, including analyzing and preparing documentation needed to meet the FHWA approval requirements for the National Environmental Policy Act and related legislation.

Equipment. All machinery, tools, and Equipment, together with the necessary supplies for upkeep and maintenance, necessary for the construction and completion of the **Contract**.

Extra Work. **Work** not provided for in the **Contract** but found by the **Project Manager** to be essential to the satisfactory completion of the **Contract** within its intended scope.

Fabricator. A **Supplier** that fabricates or supplies **Structural Steel** or other structural items.

Field Sheet. A type of **Change Order** that does not require a **Contractor's** signature.

Final Acceptance: The Department's payment of the balance due on the final payment voucher.

Free Float: The amount of time identified in a specific activity that can be Delayed without causing a Delay to successor activities.

Total Float or Float: The amount of time that an activity can be Delayed without causing a Delay to the **Critical Path** or negatively impacting the **Project** completion date.

Force Account. The **Basis Of Payment** for the directed performance of **Work**, with payment based on the actual cost of labor, **Equipment**, and **Materials**, and including various constant additives.

Fractured Face. At least one-half of the projected particle area exhibits a rough, angular, or broken texture with well-defined edges.

General Office The **Department's** main headquarters.

Hazardous Materials. Any substance, product, waste, or other **Material** of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to all applicable laws all as amended, or any other federal, state, or local statute law, ordinance, resolution, code, rule, regulation, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning any hazardous, toxic, or dangerous waste, substance, or Material.

Highway, Street, or Road. A general term denoting a public way for purposes of vehicular or pedestrian travel.

Holiday. Holidays recognized by the State of New Mexico are as follows, unless otherwise provided by the legislature:

1. 1st Day of January (New Year's Day);
2. 3rd Monday in January (Martin Luther King Jr. Day);

3. Last Monday in May (Memorial Day);
4. 4th Day of July (Independence Day);
5. 1st Monday in September (Labor Day);
6. 2nd Monday in October (Columbus Day);
7. 11th Day of November (Veterans' Day);
8. 4th Thursday in November (Thanksgiving Day);
9. 4th Friday in November (In observance of Presidents' Day Holiday); and
10. 25th Day of December (Christmas Day).

If any Holiday above falls on a Saturday or Sunday, the previous Friday or following Monday, respectively, shall be considered a Holiday.

Independent Assurance. A construction management tool in which a third party, not directly responsible for process control or **Acceptance**, provides an independent assessment of the Work, Materials, or the reliability of test results obtained from process control and **Acceptance** testing.

Incentive/Disincentive Provision. Predetermined adjustments to the **Contract** price.

Incidental. Occurring or likely to occur at the same time or as a result of other items of **Work** as specified in the **Contract** for which no separate or additional payment will be made. Unless otherwise indicated in the Contract, Incidental costs shall be included in the Contractor's Bid Item Unit Price for Bid Item 621000 Mobilization.

Inspector. Individual assigned to make detailed inspections of Contractor's Work.

Job Mix Formula (JMF). The combined aggregate gradation and the percentage of each **Material** component in the mix.

Laboratory. A testing **Laboratory** of the **Department, Contractor** or any other testing **Laboratory** that is AMRL Certified.

Landscape Architect. The individual in charge of Landscape Architecture for the Department.

Lighting and Signal Engineer. The **Engineer** in charge of the **Department's** signal and lighting design.

Luminaire (Luminaries). A lighting device designed to illuminate the surface of a specific area from a mounting on a **Standard**, including the housing, optical control, lamps, and necessary ballasts.

Lump Sum. The price bid by a Contractor as a single amount for a complete Contract Item as defined by the specifications, or price proposed by a Contractor as a single amount for the performance of **Extra Work**.

Major Contract Item. Any item, excluding mobilization, having a **Bid Item Price** of ten percent (10.0%) or more of the **Total Bid Amount** for the **Contract**, minus the amount **Bid** for mobilization.

Mandatory Completion Date. The date on which the **Project** shall be completed. This may be either **Substantial Completion** or **Physical Completion** as specified in the

Contract. If neither is specified, it shall mean "**Substantial Completion.**"

Materials. Any substances specified for use in the performance of the Work.

Median. That portion of a **Highway, Street or Road** separating the **Traveled Way** for traffic in opposing directions.

Method of Measurement. The method in which a **Pay Item** is measured to conform with the **Pay Unit**.

Nominal Maximum Sieve. One (1) sieve size larger than the first sieve that retains ten percent (10%) or more of a given **Material**.

Non-Conformance. Contractor's failure to comply with the **Contract**. **Non-Conformances** are subject to a withholding of 25% of the **Progress Payment**. **Non-Conformance** withholdings will be paid at the subsequent **Progress Payment** following resolution of all **Non-Conformances**.

Notice of Preliminary Award of Contract. The Department's written notification issuing preliminary award that is provided before the Contractor and the Department execute the Contract.

Notice to Proceed. Written notice to the **Contractor** to proceed with the **Contract Work** including the beginning date of **Contract Time**.

Notice to Contractors. An addition to the **Contract** made prior to Advertisement.

Observation Angle. The angle between the axis of incident light and the observation axis.

Partial Suspension. The suspension of **Work** on some, but not all **Contract Items**.

Pavement Structure. The combination of **Subbase, Base Course, and Surface Course** placed on a **Subgrade** to support and distribute the traffic load to the **Roadbed**.

Pay Adjustment. An adjustment to a payment for a specific portion of the **Work** based on the quality of the **Work** performed by the **Contractor** and **Accepted** by the **Department**. Other **Department** documents may refer to this term as disincentives, incentives, pay reductions, price adjustments, or price reductions.

Pay Unit. The unit of measurement for Acceptable Work.

Petrographer. Individual with credentials in the study of petrography.

Physical Completion. All the **Work** is physically completed on the **Project** and is **Accepted** by the **ADE-Construction**. . All documentation required by the **Contract** and by law shall be furnished by this date.

Pit Agreement. An agreement between the Contractor and property owner to provide **Material**.

Plans. The Professional Engineer stamped and approved **Contract** drawings showing profiles, typical cross sections, that shows the location, character, dimensions, and general or specific details of the **Work** to be done or exact reproductions of the same.

Post Construction Plans. Final drawings reflecting **Work** and quantities performed under

the **Contract**.

Pre-Bid Due Diligence. The **Bidder's** exercise of due diligence before submittal of a **Bid** which includes the careful, independent examination of the site of the proposed **Work**, including **Materials** pits and haul **Roads**, the **Bid Package**, all **Contract** documents including **Standard Specifications**, **Special Provisions**, **Supplemental Specifications**, and standard drawings and b which are representative of the condition at the precise location where each boring was made but conditions may vary between boring locations.

Pre-Cast Inspector. The Department's authorized representative as indicated in the **Contract**.

Pre-Construction Conference. A meeting between the **Department** and the **Contractor** prior to any **Work** taking place to review and discuss **Contract** requirements.

Pre-Deck Conference. A meeting between the **Department** and the **Contractor** prior to the commencement of deck placement operations to review, discuss and coordinate the **Work** associated with the deck placement.

Pre-Drilled Shaft Conference. A meeting between the Department and the Contractor prior to the commencement of drilling operation to review, discuss and coordinate the **Work**.

Pre-Fabrication Conference. A meeting between the **Department** and the **Contractor** prior to any fabrication **Work** taking place.

Pre-Pave Conference. A meeting between the **Department** and the **Contractor** prior to the commencement of paving operations to review, discuss and coordinate the **Work** associated with paving operations.

Pre-Pile Driving Conference. A meeting between the Department and the Contractor prior to the commencement of pile driving operations to review, discuss and coordinate the **Work**.

Pre-Seeding Conference. A meeting between the Department and the Contractor prior to the commencement of seeding operations to review, discuss and coordinate the **Work**.

Professional Service. Is a service provider that may or may not be a **Subcontractor**, who provides a specialized service requiring professional licensure by the State of New Mexico, e.g. Professional Engineers, Professional Surveyors and Attorneys. The professional service distinction in this **Contract** is separate from the professional service definition in the Department of Workforce Solutions regulations.

Profile Grade. The location of the **Profile Grade** will be designated by the **Department** and shown on the **Plans**. The profile grade line is usually the centerline and elevation to which the Roadway will be built. The **Profile Grade** may be used to designate the gradient and elevation of other construction features such as tops of curb, channels, **Sidewalks**, etc.

Progress Payment. A monthly payment, including zero dollar (\$0.00), provided by the **Department** to the **Contractor** for **Work**, subject to adjustment by the **Department**.

Project. The specific section of property on which **Work** is to be performed as specified in the **Contract**.

Project Manager. The **Department's** representative who is delegated the responsibility for administration of the **Project**.

Project Limits. The beginning of the Project (BOP) to the end of the Project (EOP) as designated in the Contract.

Punch List. A list, prepared by the **Project Manager**, of corrective **Work** items not conforming with the Contract and to be completed by the **Contractor**. The final Punch List is provided after **Substantial Completion** but before **Contractor's** request for final inspection. The **Punch List** is limited to items of the **Work** that are necessary to correct minor imperfections, deficiencies and deviations from the requirements of the **Contract** but which have no Material or adverse effect on the full operability of the **Project** for its intended purpose and may be safely and effectively used by the public without Delay, disruption, or impediments.

Quality Assurance (QA). The **Department's** sampling, testing, inspection, and other activities to determine payment and make **Acceptance** decisions. Includes Quality Control, Acceptance by the agency, and use of qualified laboratories by both parties

Quality Control (QC). The Contractor's actions and considerations necessary to assess production and construction processes so as to control the level of quality being produced in the end product. Quality control includes sampling and testing by the Contractor to monitor and adjust its process. Quality Control does not include **Acceptance** sampling and testing by the **Department**.

Quality Level Analysis (QLA). Is equivalent to QC/QA.

Required Documents for Bid Submittal. Those documents specified for Bid Submittal including, but not limited to, Advertisement, Bid Form, Bid Schedule, Bid Guaranty, Bidder's List of Quoters, Non-Debarment Certification, Pay Equity Acknowledgment, Disadvantaged Business Enterprise Goal Form A-585, and Subcontractor's Fair Practices Act Compliance.

Resource Loading. The Contractor's assigning of resources necessary to develop an Acceptable Critical Path Method Schedule for the **Project**. **Resource Loading** shall include personnel, production rates, **Contract** dollars earned, **Materials**, facilities and **Equipment** associated with each activity within the CPM.

Lowest Responsible Bidder. The Department determined **Bidder** who submits the lowest adjusted and **Responsive Bid**. The **Bidder** shall also be responsible and when required furnish information and data to prove that its financial resources, production or service facilities, personnel, service reputation and experience are adequate to make satisfactory delivery of the services, construction or items of tangible personal property as described in the **Advertisement**.

Responsive Bid. A **Bid** which conforms in all Material respects to the requirements set forth in the **Advertisement** and the **Contract**. Material respects of a **Bid** include but are not limited to price, quality, quantity or delivery requirements.

Retainage. Five percent (5%) of the **Total Original Contract Amount** as amended by **Change Order**. The five percent (5%) shall be retained when the **Progress Payments** equal 95% of the amended **Contract** amount. The **Retainage** shall be withheld until the Department pays the amount on the proposed final payment voucher.

Right of Way (ROW). A general term denoting land or property, or interest therein, usually in

a strip, acquired for or devoted to transportation purposes.

Roadbed. The graded portion of the **Highway, Street or Road**, with top and side slopes prepared as a foundation for the **Subgrade, Pavement Structure**, and **Shoulders**.

Roadway. A general term denoting the **Traveled Way** and the **Shoulders**.

Roadway Prism. The **Roadway** construction limits within the outside limits of the side slopes.

Secretary. See **Cabinet Secretary**.

Shop drawings. Contractor, supplier or fabricator-furnished drawings or sets of drawings typically required for Department review and approval of Work components. Shop drawings shall include detailed information to compare to the Contract for approval prior to fabrication.

Shoulder. The portion of the **Roadway** contiguous with the **Traveled Way** for accommodation of stopped vehicles, for emergency use, and for lateral support of **Base** and **Surface Courses**.

Sidewalk. That portion of the **Roadway** primarily constructed for use by pedestrians.

Signal Assembly. A housing containing the required illuminated **Traffic Signal** indications (vehicular and pedestrian) mounted on a **Standard**.

Special Provisions. Additions and revisions to the **Standard** and **Supplemental Specifications** covering conditions applicable to an individual **Project**.

Specifications. A general term applied to all written provisions and requirements pertaining to performance of the **Work**.

Specific Intensity. Candlepower of the returned light at the chosen **Observation** and **Entrance Angles** for each lumen per square meter, foot-candle of illumination at the reflector on a plane perpendicular to the incident light.

Standard. In traffic lighting, a pole-type structure that supports and positions signal and lighting devices, including arms, mounting hardware, and lowering and **Breakaway** devices as required by the Contract.

Standard Drawings. Detailed drawings for specific items of **Work** approved for repetitive use.

Standard Specifications. The **Department's** book of **Specifications** approved for general application and repetitive use.

State. The State of New Mexico acting through its authorized representatives.

State Geotechnical Engineer. The **Engineer** in charge of the Department's Geotechnical Engineering/Exploration Section of the State Materials Bureau.

State Pavement Engineer. The **Engineer** in charge of the Department's Pavement Management and Design Bureau.

State Transportation Commission. The six (6) member policy board for the **Department**.

State Transportation Commissioner. An individual member of the **State Transportation Commission**.

Structures. Buildings, **Bridges, Culverts**, catch basins, drop inlets, retaining walls, cribbing, manholes, end-walls, sewers, service pipes, under drains, foundation drains, and other such features that may be encountered in the **Work**.

Structural Steel. Steel shapes, plates, H-piling, sheet piling, and any other items identified in the Contract.

Subbase. The layer or layers of specified **Material** thickness placed on a **Subgrade** to support **Surface Courses**.

Subcontractor. An individual, partnership, firm, corporation, or joint venture, at any tier, other than a **Trucker**, who is performing Work on the Project. A **Subcontractor** has no privity of **Contract** with the **Department** and has no direct or indirect cause of action against the **Department** for any **Claim** or cause of action, including nonpayment by the **Contractor**, arising out of the **Project**.

Subgrade. The portion of the **Roadbed** prepared as a foundation for the **Pavement Structure**.

Substantial Completion. The day following the last charged day and when all the following items are met:

1. All Critical Path activities on the **Project** have been completed and deemed **Acceptable**;
2. The **Project** is complete such that it can be safely and effectively used by the public;
3. The **Contractor** has requested a determination of **Substantial Completion** from the **ADE - Construction**; and
4. The **ADE - Construction** has made a determination that the **Project** is **Substantially Complete**.

For safe and effective use by the public it is the point at which all the following **Work** is complete (or as otherwise defined in the Contract):

- **Bridge** deck;
- **Pavement Structure**;
- **Shoulder**;
- Permanent signing;
- A minimum of one (1) application of striping;
- Traffic barrier;
- Signalization and Lighting; and
- Safety appurtenances.

Substructure. The **Bridge** below the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames, together with the backwalls, wingwalls, and wing protection railings.

Superintendent. The **Contractor's** agent authorized in writing to be in responsible charge of the **Project**.

Superstructure. The entire **Bridge** except the **Substructure**.

Supplemental Agreement. A type of **Change Order** that may require **Contractor** signature.

Supplemental Specifications. Approved additions and revisions to the **Standard Specifications**.

Supplier. Any individual, partnership, firm, corporation, or joint venture that manufactures, fabricates or supplies **Materials** to be incorporated into a construction **Project** but who performs no actual **Work** on the **Project** site.

Surety. The corporation, partnership, or individual, other than the **Contractor**, executing a bond furnished by the **Contractor**.

Surface Course. Layer or layers of a **Pavement Structure** designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate.

Surfacing Pit. A source from which suitable **Material** for the production of **Surface Course** aggregate is obtained.

Temporary Construction Permit (TCP). A temporary interest in land acquired in conjunction with a **Project** to provide for the temporary use of private property for the duration of the **Project** to perform construction activities as designated in the Contract.

Technical Irregularity. A minor informality or irregularity that is not a Material defect of a bid, that is a matter of form that can be waived without prejudicing other bidders, or result in a change to the order of bidders.

Termini. A general term used to describe the **Project Limits**, and including the beginning and end of the **Project**, its **Right of Way**, pit sites, haul **Roads**, and temporary and permanent construction or maintenance easements.

Total Bid Amount. The sum of all the **Bid Item Prices** on the **Bid Form**. The Total Bid Amount represents the total cost of performing all the Work described in the Contract based upon estimated quantities.

Total Original Contract Amount. The total amount **Bid** as compensation for the **Contract**.

Town, City, County or District. Subdivisions of the **State** used to designate or identify the location of the proposed **Work**.

Traffic Lanes. See **Traveled Way**.

Traffic Services Engineer. The **District Engineer's** representative for traffic engineering.

Traffic Signal. The complete installation of a traffic control system at an intersection, including the illuminated signal indications, supports, electrical controls, and distribution system.

Traveled Way. The portion of the **Right of Way** designated for the movement of vehicles, exclusive of **Shoulders** and Auxiliary Lanes.

Trucker. (Also called Trucking, Trucking Deliveries, Deliveries and Hauling) A **Trucker** is an

individual, partnership, firm, corporation, or joint venture that transports or delivers **Materials** to and from the **Project** and does not perform **Work** on the **Project** site. A **Trucker** transports, but does not place, **Materials** (i.e. pit **Materials**, plant **Materials**, fabricated **Materials**, demolished and milled **Materials**, trash and waste **Materials**).

Unbalanced Bid. A Bid containing Bid Item Unit Prices that are unbalanced, to the potential detriment of the Department. There are two types of unbalanced bids; (1) mathematically unbalanced and, (2) materially unbalanced. The mathematically unbalanced bid is a bid containing lump sum or unit pay items which do not reflect reasonable actual costs plus a reasonable proportionate share of the bidders anticipated profit, overhead costs and other indirect costs but not necessarily to the detriment of the department. These costs should be related to the performance of the items in question. The materially unbalanced bid is a mathematically unbalanced bid which the Department determines leaves reasonable doubt that award will result in the lowest ultimate cost to the Department or that award is in the public interest.

Value Engineering Cost Proposal. A **Contractor**-provided form that details an alternative to the **Work** methods or **Materials** specified in the **Contract** that establishes a better or approved-equal product or result without affecting the functional purpose of the **Work** being revised, and that produce a net savings to the **Department**.

Work. The providing of all documentation, supervision, labor, **Materials**, **Equipment**, transportation, and other **Incidentals** necessary for the successful completion of the **Project**, the successful completion of **Pay Items**, and the carrying out of the duties and obligations imposed by the **Contract**.

Working Day. Every **Day** except Saturdays, Sundays, and **Holidays**. Based on a review of weather conditions and the actual **Work** performed by the **Contractor**, the **Project Manager** will determine (between the end of the **Day** and noon of the next **Day**) if the **Department** will charge a **Working Day**. If the **Contractor Works** for six (6) or more hours on a Saturday, Sunday, or **Holiday**, a **Working Day** will be charged.

Working Drawings. **Contractor**-furnished documents including, but not necessarily limited to:

1. Stress sheets;
2. Shop drawings;
3. Bending diagrams for reinforcing steel;
4. Plans for erection, false **Work**, frames **Work**, cofferdams, and other items; and
5. Such other similar data required for the successful completion of the **Work**.

SECTION 102: BIDDING REQUIREMENTS AND CONDITIONS

102.1 RESERVED

102.2 PREQUALIFICATION

Prequalification of Bidders is a condition for submitting a Bid as authorized by the New Mexico Procurement Code, NMSA 1978, § 13-1-82 and 13-1-134 (1984, amended 2011).

Bidders shall be prequalified in accordance with 18.27.5 NMAC.

102.3 SUSPENSION AND DEBARMENT

The Department may suspend, debar, reject a Bid as non-responsive, prohibit from the performance of Work, or terminate a Contract with any Bidder, Contractor, Subcontractor, at any tier, Suppliers, individual officers, directors in accordance with NMSA 1978, § 13-1-177 to 13-1-180 (1984, as amended 2011) and the Department's Suspension and Debarment rules as per 18.28.4 NMAC.

102.4 REQUIRED DOCUMENTS FOR BID SUBMITTAL

The Department will make available to prospective Bidders the Required Documents for Bid Submittal. The Project's Required Documents for Bid Submittal are those specified in the Contract's Index of Required Documents for Bid Submittal.

102.5 REJECTION OF BIDS

102.5.1 Mandatory Rejection of Bids

The Department reserves the right to reject any or all Bids, to waive technicalities, or to advertise for new Bids if, in the judgment of the Department, the best interests of the public and the Department would be promoted thereby. The Department will reject Bid(s) for the following reasons:

1. A Bidder is not Prequalified;
2. A Bidder is determined to be a non-Responsible Bidder;
3. A Bidder fails to comply with any requirement in the Contract documents;
4. A Bidder omits any portion of the Required Documents for Bid Submittal when submitting its Bid;
5. A Bidder adds provisions reserving its right to Accept or reject an Award, or reserving its right to refuse to enter into a Contract after an Award;
6. A Bidder defaults under a previous Contract, including Contracts with other public entities;
7. The Bidder or its principals, individual officers or corporate directors are presently suspended, debarred, declared ineligible, or voluntarily excluded from bidding;
8. The Department issued a notice of proposed Suspension or Debarment to the Bidder and the Bidder failed to timely respond to the notice of proposed Suspension or Debarment;
9. A Bidder submits more than one (1) Bid for the same Project control number;
10. A Bid Item Unit Price results in an Unbalanced Bid. The Department may require the Apparent Low Bidder to detail and justify in writing how its prices were determined;

11. A Bidder contacts or communicates with any State Transportation Commissioner or any Department personnel responsible for Bid review or the Award of the Contract in relation to the Bid review or Award process before the Department's execution of the Contract , except for a response to an inquiry from the Bid review committee; or
12. A Bidder is subject of a judgment or verdict imposing a civil or criminal penalty under either the Federal False Claims Act or the New Mexico Fraud against Taxpayers Act.

102.5.2 Discretionary Rejection of Bids

The Department may reject Bid(s) for the following reasons:

1. A Technical Irregularity exists;
2. A Bid Item Unit Price or Total Bid Amount differs significantly from the Engineer's Estimate or from other Bids;
3. A Bidder is responsible for uncompleted Work that might reasonably be expected to hinder or prevent the prompt completion of additional Work;
4. A Bidder fails to timely pay, satisfactorily settle, or provide security for the payment of Claims for labor, Equipment, Materials, supplies, or services legally due on previous or ongoing Contracts;
5. A Bidder performs previous Work unsatisfactorily, or fails to comply with Section 108.4, "Unsatisfactory Progress of Work";
6. The Department issues a notice of proposed Suspension or Debarment to the Bidder;
7. Evidence exists of collusion among Bidders or prospective Bidders; If the Department becomes aware of an error in the quantity of a Bid Item shown in the Bid Schedule, Plans, or other Contract documents which may call into question the Department's ability to determine which Bid will result in the lowest ultimate cost to the Department;
8. To redesign the Project or change the Contract;
9. A potential benefit to the public or the Department exists if the Contract is re-advertised; or When it is in the best interests of the public or the Department.

102.6 INTERPRETATION OF QUANTITIES

The quantities appearing in the Contract are approximate only and are prepared for the comparison of Bids. Payment to the Contractor shall be made only for the actual quantities of Work performed and Accepted, or Materials furnished, or as otherwise specified (e.g., Computed Quantities) in the Contract.

102.7 EXAMINATION OF CONTRACT, SITE OF WORK, AND REQUESTS FOR CONTRACT INTERPRETATION

1. The submission of a Bid shall be considered conclusive evidence that the Bidder has exercised Pre-Bid Due Diligence and Accepts the conditions to be encountered in performing the Work and Accepts the provisions and requirements of the Contract.
2. When available, subsurface investigation records related to the Project will be provided by the Department through bid express. When a log of test borings is included in the subsurface investigation record, the data shown in the individual log of each test boring apply only to that particular boring and are not intended to be

conclusive as to the character of any material between or around test borings. If Bidders use this information in preparing a Bid, it is used at its own risk, and Bidders are responsible for all conclusions, deductions, and inferences drawn from such information. If the Bidder requires additional information other than what the Department furnished the Bidder may, at its own expense, and with Department approval perform its own site investigation. The Department providing subsurface investigation information does not relieve the Bidder from considering geotechnical data from previous Projects performed by the Bidder in the vicinity of the Project, and determining how subsurface conditions may affect the means, methods and cost of the Work. "The Bidder shall carefully study and compare all Contract documents and shall immediately report to the Chief Engineer any error, inconsistency or omissions that may be discovered."

102.7.1 Requests for Contract Interpretation

1. Requests for Contract interpretation shall be in writing, addressed to the Chief Engineer at chief.engineer@state.nm.us and must be received by the Chief Engineer at least 72 hours before the Bid Opening time in the Advertisement in order to receive a written response to the request. The Department will not be bound by any statement or representation concerning the Work unless it is included in the Contract. The Bidder shall only rely on written responses from the Chief Engineer or designee and oral responses, explanations, interpretations, or instructions given before the Bid Opening by the Department, its employees or agents, are not binding. Written responses from the Chief Engineer will be posted to Bid Express. Written responses will be provided, whenever practicable, no later than twenty-four (24) hours prior to Bid Opening.
2. The Bidder shall take no advantage of any error or omission in the Contract. In the event the Bidder discovers an error or omission, the Bidder shall notify the Chief Engineer in writing. The Bidder also agrees that it will make no Claim because of misinterpretation or misunderstanding of the Contract or because of lack of information; and
3. If a written response by the Department to a request for Contract interpretation is not provided, the Bidder shall Bid the Contract according to the Contract documents.

102.8 PREPARATION OF BID

1. Submit the Bid as provided in the Advertisement;
2. Specify a Bid Item Unit Price for each Bid Item, except when a Bid Item Unit Price is established by the Department;
3. Show the amounts for the respective Bid Item Unit Prices to a maximum of three (3) decimal places. Round additional decimal places in excess of three (3);
4. Exclude the applicable State GRT, local option tax, Indian business tax, TERO tax, and other tax imposed by a tribal government. The Department will pay the applicable tax or increase in the applicable tax effective after the Contract is executed by the Department; and
5. The Standard Specifications and, when applicable, supplemental Specifications are organized by section numbers that describe the Work, Materials, construction requirements, methods of measurement, and Basis of Payment. The Bid Item numbers correlate to section numbers; the first three digits of a Bid Item code correspond to the Specification section number with the same first three digits. Payment for Work will be made only for and under those Bid Items included in the Bid Schedule. If no Bid Item appears on the Bid Schedule for any Work or Materials required or specified by the Contract, such Work and Materials shall be Incidental to

the Contract and the cost of such Work shall be included in any Bid Item(s) related to or associated with such Work. For the convenience of the Contractor, some Contract documents may specify Work which is incidental; identification of such incidental items of Work is not all-inclusive.

102.9 INNOVATIVE INCENTIVE/DISINCENTIVE PROVISIONS

The Department reserves the right and may include innovative Incentive/Disincentive Provisions in the Contract.

102.10 RESERVED

102.11 BID GUARANTY

A Bidder shall submit with the Bid, a Bid Guaranty in the amount of five percent (5%) of the Total Bid Amount. The requirement of the Bid Guaranty is to ensure that the Bidder will promptly execute the Contract in accordance with the Advertisement and in the manner and form required by the Contract Documents and that the Bidder will furnish good and sufficient Contract Bonds and required insurance. The Bid Guaranty shall be in the form in the Required Documents for Bid Submittal. The Bid Guaranty will remain in force up to 30 Days after Bid Opening, or until Award of Contract as it may be extended by the NMDOT, notice of which extension(s) to the surety is hereby waived.

102.12 RESERVED

102.13 RESERVED

102.14 WITHDRAWAL OF BIDS

A Bidder may withdraw its Bid before Bid Opening or may choose circumstances for the operation of the automatic Bid withdrawal functionality. Once a Bid Opening has commenced at the date, time and place designated in the Advertisement Bids may not be withdrawn.

102.15 RESERVED

102.16 ENGINEER'S ESTIMATE

The Engineer's Estimate shall be confidential and is not subject to the Inspection of Public Records Act and shall not be disclosed to, or be subject to inspection by, members of the public before Bid Opening. At Bid Opening the Engineer's Estimate for the Project will be publicly disclosed.

SECTION 103: AWARD AND EXECUTION OF CONTRACT

103.1 CONSIDERATION OF BIDS

The Department's Bid Review Committee shall review, evaluate Bids and make recommendations for rejection or issuance of the Notice of Preliminary Award. The Department's Bid Review Committee will review the Bid Item Unit Pricing to determine if the Bid Item Unit Pricing is responsive, unbalanced either materially or mathematically, or any other abnormalities exist. The Department reserves the right to request justification from the Bidder for any aspect relating to its Bid and the Bidder shall respond to the request. The results of the completed analysis will be available to the public after the Department issues the Notice of Preliminary Award of Contract letter.

If two (2) Contractors submit identical lowest Total Bid Amounts, the Department shall determine the successful Bidder by the flip of a coin.

Any or all Bids may be rejected when it is in the best interest of the public and the Department at any time prior to execution of the Contract. If all Bids are rejected the Department may issue a new Advertisement. A Department decision to reject all Bids, rescind the Notice of Preliminary Award of Contract, or to cancel the Award of Contract and issue a new Advertisement is wholly an exercise of executive discretion not subject to review at an informal hearing pursuant to Section 103.3, "Bidding Dispute Resolution Procedures".

103.2 NOTICE OF PRELIMINARY AWARD OF CONTRACT

Except as described in Section 103.3, "Bidding Dispute Resolution Procedures," the Department will issue the Notice of Preliminary Award of the Contract within 30 Days after Bid Opening to the lowest Responsible Bidder. Bidders may agree to a later Notice of Preliminary Award time if requested to do so by the Department, failure to agree to a later Notice of Preliminary Award time as requested by the Department will be deemed the Bidder's withdrawal of its Bid. The Notice of Preliminary Award letter, if it is mailed within 30 Days of the Bid Opening, shall bind the lowest Responsible Bidder to Accept the Contract or to reject the Contract and forfeit the Bid Guaranty it has provided.

103.3 BIDDING DISPUTE RESOLUTION PROCEDURES

103.3.1 Bidding Disputes

1. A Bidder aggrieved in connection with the solicitation or Notice of Preliminary Award of a Contract shall file a written protest within fifteen (15) Days of the Notice of Preliminary Award of a Contract. Written protests filed prior to the Department's Notice of Preliminary Award of Contract may be deferred at the sole discretion of the Department and not considered until the Department has issued the Notice of Preliminary Award of Contract.

103.3.2 Reserved

103.3.3 Informal Hearing Procedures

1. Failure to file a timely protest shall constitute a waiver of the Bidder's right to protest and the Bidder is not entitled to an informal hearing;
2. The written protest must include facts supporting the protest, any pertinent contractual provisions, law, rules or regulations, and other legal authorities supporting the protest and a requested action;

3. Service of the written protest shall be made upon the Cabinet Secretary, with a copy contemporaneously transmitted and separately served upon the Office of General Counsel for the Department, during the Department's regular Business Hours by delivery in person, or by certified mail, postage prepaid, return receipt requested, or by delivery by a nationally recognized overnight or same-day courier service that obtains receipts. Electronic communication (i.e. e-mail, facsimile) shall not be considered. Service of a written protest made after the Department's regular Business Hours shall not be effective until the next business Day;
4. Copies of the protest shall be contemporaneously transmitted by the disputing Bidder to every Bidder when the protest is served upon the Cabinet Secretary and the Office of General Counsel;
5. Any Bidder, other than the disputing Bidder, that considers itself to be an interested party to the Bidding dispute may submit a written response to the protest in advance of the informal hearing. The response shall include a statement of the requested action, a rebuttal of any of the factual matters in the protest, facts supporting the response, and any contractual provisions, laws, rules, or regulations, or other authority supporting the response;
6. When a timely protest is filed, the Cabinet Secretary will not proceed further with the Award by execution of Contract until the dispute is resolved, as detailed below, unless or until the Cabinet Secretary determines that the Award or execution of the Contract is necessary to protect the best interests of the public and the Department. The Cabinet Secretary retains the right to reject all Bids, to rescind the Notice of Preliminary Award of Contract, or cancel the Award of Contract and issue a new Advertisement when it is in the best interest of the public and the Department;
7. When a timely protest is filed, the Bids of both the Apparent Low Bidder and the next Apparent Low Bidder (or all Bidders) shall be automatically extended an additional 15 Days. The Department will, subject to other provisions in the Specifications, may Award the Contract by executing the Contract within 45 Days of the Bid Opening;
8. Within seven (7) Days of receiving a timely Bid protest, the Cabinet Secretary or the Cabinet Secretary's designated informal hearing officer will cause to be delivered by mail, postage prepaid, or by facsimile copy or by email transmission a letter notifying all parties to the protest of the date, time and place to appear with all necessary Material evidence for an informal hearing. Such letter shall include a copy of the written protest. Whenever practicable the parties will be afforded at least seven (7) Days' notice of the scheduled informal hearing. If an informal hearing officer is designated by the Cabinet Secretary, the designee shall not be a person who made or approved the Award decision under review or a subordinate of such person during the past 12 months;
9. The formal rules of evidence or civil procedure do not apply to the informal hearing. The informal hearing officer has absolute discretion in establishing the degree of formality for the informal hearing and may limit the presentation of evidence or argument. While parties to an informal hearing may call their own witnesses they are not afforded the opportunity to subpoena or cross-examine witnesses. Parties are permitted to submit documentary evidence and written arguments at the informal hearing. Parties may supplement the record or provide supplemental written arguments after the informal hearing date provided that such Materials are submitted to the informal hearing officer three (3) Days after the information hearing date. The informal hearing officer shall have the authority to question any party or witness;
10. At disposition, the informal hearing officer is not restricted to considering only evidence or argument presented at the informal hearing but may consider evidence

that is reliable, accurate, and competently obtained. When such information is obtained the hearing officer shall provide it to both parties and provide 24 hours for rebuttal before the final decision.

11. The informal hearing officer is responsible for maintaining a complete record of the informal hearing including all evidence, transcripts of the hearing, and written arguments submitted by the parties. A complete record of the testimony and argument at the informal hearing shall, whenever practicable, be either stenographically or electronically recorded by a certified court reporter or monitor. Transcripts or recordings of the proceeding, if available, may be supplied to any party at their own expense upon request to the court reporter or monitor;
12. Within seven (7) Days of the informal hearing date, the Cabinet Secretary or the Cabinet Secretary's designated informal hearing officer will issue a determination letter stating the reasons for the action taken and informing the losing party of its right, under NMSA 1978, § 13-1-183 (1984), to file an appeal in Santa Fe District Court within 30 Days of the issuance of the adverse determination. The determination letter shall constitute the final Department decision or order;
13. The Award of the Contract to the lowest Responsible Bidder, based upon the Department's determination letter, shall be conditioned upon the unsuccessful party not appealing, under NMSA 1978, § 13-1-183 (1984), to the Santa Fe District Court within 30 Days of receiving the determination letter. The Award letter, if it is mailed within 60 Days of the Bid Opening, shall bind the lowest Responsible Bidder to Accept the Contract or to reject the Contract and forfeit the Bid Guaranty it has provided;
14. If an appeal is filed pursuant to NMSA 1978, § 13-1-183 (1984), the Department may extend the date of the Award letter to a later date as agreed upon by the Department and the lowest Responsible Bidder. When such an extension cannot be agreed upon or for any other reason, the Department may proceed with the Award to the next lowest Responsible Bidder if the Cabinet Secretary determines that the Award of the Contract is necessary to protect the substantial interests of the public and the Department, or may cancel the Award of the Contract, or reject all Bids and issue a new Advertisement when it is in the best interest of the public and the Department;
15. If a Bidder successfully prevails on appeal, a Bidder is limited to one (1) of two (2) remedies arising from the Bid dispute, Award of the Contract or, if the Contract can no longer be practicably awarded to the Bidder or it is not in the best interest of the public and the Department to Award the Contract to the Bidder, the Contractor's reasonable and documented Bid preparation costs; and,
16. Each party shall bear its own attorney's fees and costs.

103.4 CANCELLATION OF AWARD

The Department may reject all bids, rescind the Notice of Preliminary Award of Contract, and cancel the Award of any Contract at any time prior to the execution of the Contract by all parties without incurring liability where such cancellation is deemed by the Cabinet Secretary to be in the best interests of the public and the Department. No Bidder has a contractual, equitable, implied, or any other right to the Contract until executed by both parties.

103.5 RESERVED

103.6 CONTRACTOR EXECUTED CONTRACT

The Department will provide the Contract to be executed by the Contractor and returned to the Department. The Contractor shall return the signed Contract with Contract Bonds and

other documents required by the Notice of Preliminary Award letter within the 15 Days from the date of the letter. The Contract Bonds shall become binding upon Contract execution.

The value of each bond shall equal the Total Original Contract Amount.

All Contract Bonds shall be procured from Sureties with an A.M. Best Company financial strength rating level of A- or better, Class VII or better, unless otherwise approved in writing by the Department. In no event shall the Department approve the use of a Surety with an A.M. Best Company financial strength rating level of B or worse.

103.7 FAILURE TO EXECUTE CONTRACT

Failure by the lowest Responsible Bidder to return the signed Contract, Contract Bonds and other documents required by the Notice of Preliminary Award letter within 15 Days of receiving the letter shall constitute just cause for rescinding the Notice of Preliminary Award of Contract and the forfeiture of the Bid Guaranty which shall become the property of the Department, not as a penalty but as liquidation of reasonable damages sustained. The Bid Guaranty remains in effect until the Department has fully executed the Contract. The Department may then issue the Notice of Preliminary Award of the Contract to the next lowest Responsible Bidder or take other actions as the Department may decide.

103.8 EXECUTION OF CONTRACT

If the Department fails to execute the Contract within 30 Days of receiving the signed Contract, Contract Bonds, and other documents required by the Notice of Preliminary Award Letter from the successful Bidder, the Bidder may withdraw its Bid without penalty. No Contract shall be effective until it has been fully executed by the Department and the Contractor. In no event shall the Contractor commence Work until after execution of the Contract by all parties.

SECTION 104: SCOPE OF WORK

104.1 INTENT OF THE CONTRACT

The intent of the Contract is to provide for the construction and completion of the Work to the satisfaction of the Department. The Contractor shall furnish experienced supervision and labor and all Materials, Equipment, tools, transportation and supplies required to complete the Work in accordance with the Plans, Specifications and terms of the Contract.

Unless otherwise specified in the Contract, the Contractor is vested with the discretion and is wholly and solely responsible for selecting and managing the means and methods for performing the Work.

104.1.1 CONTRACT MODIFICATIONS

No modifications, limitations, waivers or discharge of the Contract or any of its terms shall bind the Department unless made in a written Change Order signed by the Project Manager. A course of performance or course of dealing on this Contract or any other contract between the Department and a Contractor shall not constitute a modification or waiver of the Contract and shall not give rise to any Claim including any cause of action based upon promissory estoppel, estoppel, waiver, or detrimental reliance.

104.2 EXTRA WORK

The Department reserves the right to modify the Contract at any time. Such revisions shall neither invalidate the Contract nor release the Surety. The Contractor agrees to complete the Contract as revised. The Contractor shall perform Work at the Department's written direction defining the scope of the Work and in accordance with the Specifications.

The Contractor shall provide to the Project Manager its proposal associated with the Work before starting the Work. The submission of the proposal shall not be considered Accepted by the Department until the Acceptance of the cost proposal is in writing from the Department. If the proposal is Accepted by the Department, then the Department will issue a Change Order and allow the Contractor three (3) Days to review and sign the Change Order. If, after the expiration of three (3) Days, the Contractor has failed to sign the Change Order the Department may process the Change Order unilaterally.

104.2.1 SIGNIFICANT CHANGES IN THE CHARACTER OF THE WORK

The Project Manager reserves the right to make, in writing, at any time during the Work, modifications in quantity and alterations to the Work as are necessary to satisfactorily complete the Project. "Significant change" applies only to modifications or alterations that:

1. Materially changes, in kind or nature, the character of the Work including the Critical Path from that which was previously involved or included in the original proposed construction. When the character of the Work is materially changed in kind or nature then the Project Manager and the Contractor shall agree upon the adjustment prior to the Contractor's performance of the Work. If an agreement is reached, the Project Manager will make an adjustment to the Contract which excludes anticipated profit. If an agreement is not reached, the Project Manager will direct the Contractor to perform the Work. The Project Manager and the Contractor will track the costs in accordance with Section 109.6, "Force Account;"
2. A Major Item of Work, as defined elsewhere in the Contract, has increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. The Project Manager and the Contractor may negotiate adjustments to the

Contract when it is discovered that a Major Contract Item of Work, as defined elsewhere in the Contract, has increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity. In the case of a decrease below 75 percent, the allowance will apply to the actual amount of work performed. For quantities below 75 percent, before an adjustment is made, the Contractor shall provide documents, including invoices, to the Project Manager justifying the requested adjustment price. If the final quantities are reestablished to be within the thresholds of 75% to 125% of the original item quantity then the original bid item price applies; and,

3. Affects Work performed under a Subcontract, as solely determined by the Project Manager. The Project Manager will make adjustments if the Contractor demonstrates that the change adversely affects the Subcontractor's Work.

The Department shall not consider customary increases or decreases in quantities necessary to complete the Work changed by the Contractor's schedule of operations, the Contractor's planning of the Work, or unscheduled mobilizations.

104.2.2 DIFFERING SITE CONDITIONS

The Contractor shall carefully study and compare the foundation reports and geotechnical reports and Contract documents and shall immediately report to the Project Manager any error, inconsistency, or omission that it discovers. If the Contractor does not understand information in the foundation report and geotechnical report, it shall immediately seek clarification from the Project Manager. The Contractor and the Project Manager shall provide, immediately upon discovery written notice of the following conditions encountered on the Project during the progress of the Work:

1. Present but not visible physical conditions differing materially from those shown in the Contract; or,
2. Unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the Work.

The Project Manager will decide, within a, two (2) Working Days, after written notification, whether the conditions materially differ and cause an increase or decrease in the cost or time required to perform the Work.

The Project Manager will notify the Contractor of this decision and the Contractor shall not proceed with Extra Work until the Project Manager provides direction.

The Project Manager will adjust the Contract for differing site conditions in accordance with Section 109.5, "Payment for Changes, Differing Site Conditions, and Extra Work," and will include the costs of Delays but exclude anticipated profit in accordance with Section 109.11, "Compensation for Claims." The Department may grant time extensions only to the extent that the activities on the Critical Path of the Baseline Schedule in effect at the time of the Delay are impacted. No Contract adjustment which results in a benefit to the Contractor will be allowed if a differing site condition could have been discovered or anticipated by the Contractor through the exercise of Pre-Bid Due Diligence.

104.2.3 DEPARTMENT ORDERED WORK

The Department shall pay for Department ordered Work in accordance with Section 109.5, "Payment for Extra Work".

The Department may grant time extensions only to the extent that the activities on the Critical Path of the Baseline Schedule in effect at the time of the Delay are impacted.

104.3 RESERVED

104.4 RESERVED

104.5 MAINTENANCE OF TRAFFIC

The Contractor shall furnish traffic control devices, take protective and safety measures, and complete the Work. If the Contractor fails to do so, the Project Manager will notify the Contractor in writing of the deficiency and the Contractor shall take corrective action within the time frame specified by the Project Manager. Failure by the Contractor to take the corrective action as directed by the Project Manager shall result in the Department assessing to the Contractor the incurred costs for the corrections plus an additional 10% for administrative costs.

The Contractor shall not endanger the traveling public when moving Equipment on or across the ROW and Roadway. The Contractor's Equipment shall enter and leave the ROW and Roadway in the direction of the Traveled Way, except with the written approval of the Project Manager.

The Project Manager may direct the Contractor to maintain the pavement surface. The Department will pay for this Work in accordance with Section 109.5, "Payment For Changes, Differing Site Conditions, and Extra Work."

The Department is responsible for snow removal on sections of Roadway open to the traveling public. The Project Manager will coordinate snow removal with the Contractor and the maintenance patrol.

The Contractor shall furnish warning devices, take protective and safety measures, and complete Shoulder Work, drainage Structures, or other features of the Work. If the Contractor fails to do so, the Project Manager will notify the Contractor in writing of the deficiency and the Contractor shall take corrective action within the time frame specified by the Project Manager.

The Contractor shall provide reasonable vehicular and pedestrian ingress and egress to adjoining properties during the duration of the Contract. The Contractor shall advise and schedule access modifications with local business owners and residences and the Project Manager at least 24 hours in advance.

The Contractor shall not open partially completed sections of the Traveled Way unless directed or approved by the Project Manager. If the Traveled Way is opened at the Contractor's request, the Contractor remains liable for costs associated with the opening until Final Acceptance of the Project. The Project Manager will provide written instructions approving any sections which are to be opened. Such an opening shall not constitute a full or partial Acceptance of the Work or a waiver of any Contract provisions.

104.6 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK

The Contractor may use Materials found in the excavation for completing Pay Items other than the Work in Standard Specification Section 203, "Excavation, Borrow, and Embankment." Payment will be made for both the excavation of such Materials at the corresponding Contract Unit Price and for the Pay Item for which the excavated Material is used.

If the excavated Material would have been used to construct Embankments or Bridge approaches or for other purposes, any of which would have been required to complete the Contract, the Contractor shall replace the excavated Material with Acceptable Material at no additional cost to the Department. The Department will not charge the Contractor for the use of the excavated Material. The Contractor shall obtain written authorization from the Project Manager before excavating Material that is within the Right of Way but outside the grading limits, as shown by the slope and grade lines. Prior to granting approval, the Project Manager will verify that the requirements of Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" have been met. If not previously cleared environmentally, meeting these requirements will be the responsibility of the Contractor.

Unless otherwise provided, the Contractor may temporarily use the Material from existing Structures in the erection of a new Structure but shall not, without the approval of the Project Manager, cut or otherwise damage such Materials.

104.7 FINAL CLEANUP

Pits located on state or federal land are governed by the appropriate requirements of their agency. The requirements of this section do not apply to a commercial source.

Before Final Acceptance all areas occupied by the Contractor or in connection with the Work shall be cleaned of all Deleterious Material, rubbish, excess Materials, temporary Structures and Equipment, and all parts of the Work shall be left in a condition Acceptable to the Project Manager or otherwise required by the Contract. To avoid the requirement of removal of Equipment from private property before Final Acceptance, the Contractor shall make appropriate arrangements with private property owners and provide documentation of the arrangement to the Project Manager.

The Contractor shall not allow Borrow Pits and Surfacing Pits to change the general pattern of existing drainage. Unless Borrow Pits or Surfacing Pits are suitable to develop as ponds or lakes and the property owner has notified the Department in writing that such development is planned, the Contractor shall where practicable leave all pits well drained.

The Contractor shall, when excavation is complete, contour grade pits, except quarry pits, to blend with the natural topography of the surrounding area or in accordance with the Contract or agreements with the property owners.

104.8 VALUE ENGINEERING COST PROPOSAL (VECP)

The Department under no circumstances will reimburse the Contractor for the costs of developing the VECP that is rejected or is not Accepted by the Department. The Contractor shall submit its VECP on the Department provided form only. Exempted from Value Engineering Cost Proposals are mix designs and traffic control. Any decision about whether to Accept a VECP shall be in the sole discretion of the Department. A VECP shall not be considered Accepted until the Department approves a Change Order implementing the VECP. VECPs are reviewed on a case by case basis and apply only to the ongoing Contracts referenced in the VECP proposal and become the property of the Department upon approval of the Change Order. VECPs shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department has the right to use, duplicate and disclose in whole or in part any data necessary for the utilization of the VECP. The Department retains the right to utilize any accepted proposal or part thereof on other Projects without obligation or compensation to the Contractor.

The Contractor's share of the VECP is fifty percent (50%) of the net savings. In no event shall the Contractor be entitled to an extension of Contract Time for the Department's

consideration a VECP, the refusal to accept or approve such a proposal, or any other matter connected with a VECP.

The Department will rely exclusively upon the accuracy of the engineering data upon which the VECP is based and will not be required to perform additional investigations, crosschecks, or site examinations. The Department's Acceptance or adoption of a VECP shall not be construed to alleviate or reduce the Contractor's full and absolute liability if the implementation of the proposal fails to satisfactorily perform.

SECTION 105: CONTROL OF WORK

105.1 RESPONSIBILITY AND AUTHORITY OF THE DEPARTMENT

105.1.1 The Department has the authority to:

1. Administer the Contract;
2. Alter the Contract;
3. Enforce and terminate the Contract as expressly provided in other sections of the Standard Specifications;
4. Wholly or Partially Suspend the Work for cause; and,
5. Take actions as determined to be in the public's best interest.

If the Work is suspended by the Project Manager in writing for an unreasonable time (not originally anticipated, customary, or inherent to the construction industry), the Contractor may submit to the Project Manager a Notice of Intent to Claim in accordance with Section 105.19, "Notice of Intent to Claim" which must be accompanied by a proposed revised schedule pursuant to Section 108.3, "Schedule."

105.1.2 Contractor Convenience

The Contractor shall be wholly responsible and liable for any costs or time associated with any requests made for the Contractor's convenience and approved by the Department.

105.2 PLANS, WORKING DRAWINGS

The Plans may be supplemented by Working Drawings as are necessary for the Work. The Contractor shall have the sole responsibility for verifying pertinent dimensions in the field before submitting such Working Drawings to the Project Manager. Working Drawings shall be submitted by the Contractor and Accepted by the Project Manager before beginning Work covered by the drawings. The Project Manager will review the Working Drawings although the Project Manager's review does not relieve the Contractor of the responsibility for the satisfactory completion of the Work or compliance with the Contract. The Contractor shall not alter or amend such drawings without the prior written approval of the Project Manager. The furnishing of all Working Drawings is Incidental.

The Contractor's Baseline Schedule of Work shall show the submittal of any Working Drawing as a milestone thirty (30) Days before the commencement of Work covered by the drawings. Unless otherwise indicated in the Contract, or approved by the Project Manager in writing, the Project Manager will have no longer than thirty (30) Days for Acceptance of the Working Drawings. If the Working Drawings are not Acceptable, the Working Drawings shall be resubmitted by the Contractor and the timeframe for Acceptance starts over. All time required for review of Working Drawings and other Contractor submittals shall be Incidental and shall not be the basis for any claim for Contract Time extension or additional compensation.

105.2.1 SUBMITTALS

Anything that requires approval is considered a submittal by the Department. Any submittal required, other than the Critical Path Method or Bar Graph Schedules, shall be submitted to the Department thirty (30) Days before the Work related to the submittal is performed. The Project Manager will have no longer than thirty (30) Days for Acceptance of the submittal, unless otherwise specified in the Contract.

105.3 COMPLIANCE WITH PLANS AND SPECIFICATIONS

The Contractor shall perform the Work and provide the Materials in substantial compliance with the lines, grades, cross sections, dimensions, and material requirements as specified by the Contract. The Department's failure to discover or reject Work or Materials not in substantial compliance with the Contract during the Work shall not be considered an Acceptance of the Work or Materials, or a waiver of defects. The Department's failure to properly perform inspections or tests shall not relieve the Contractor from its obligation to perform the Work and provide Materials in substantial compliance with the Contract and shall not be considered the Department's Acceptance of the Work or Materials.

If the Project Manager determines that Work or Materials are unacceptable, the Contractor shall remove, replace and correct the Work or Materials at no additional cost to the Department. The Project Manager's determination that the Work or Materials are unacceptable shall not form the basis of a claim for additional Contract Time or additional compensation.

If Work does not comply or substantially comply with the Contract, the Project Manager may determine the Work is nonetheless Acceptable. If Accepted the Project Manager will, by Change Order, provide an adjustment for Work or Materials.

105.4 COORDINATION OF CONTRACT DOCUMENTS

In case of a discrepancy, the Contract documents will govern in the following order of importance:

1. Addenda;
2. Required Documents for Bid Submittal;
3. Notices to Contractors;
4. Advertisement;
5. Special Provisions;
6. Plans;
7. Supplemental Specifications;
8. Standard Specifications; and,
9. Standard Drawings.

Dimensions given on the Plans or that can be calculated govern over scaled dimensions.

If a Contract discrepancy is discovered after the Award of the Project, the Contractor shall, upon discovery, promptly notify in writing the Project Manager. The Contractor shall take no advantage of any discrepancy or errors or omissions in the Contract. The Project Manager will resolve the discrepancy in writing before the Contractor proceeds further with performance of the affected Work.

105.5 CONTRACTOR RESPONSIBILITIES

The Contractor shall monitor the Work at all times, select and manage the means and methods for performing the Work.

105.5.1 Duties of Superintendent

The Contractor shall have on the Project at all times during the course of the Work, a competent and qualified Superintendent who:

1. Reads and understands the Contract documents; and,
2. Possesses substantial experience in the type of Work being performed.

The Contractor and its Superintendent shall communicate with the Project Manager as the Department's contact for all matters relating to the Project and promptly submit all documentation or notice required by the Contract to the Project Manager.

105.6 COOPERATION WITH UTILITIES

The Contractor shall comply with the Notice to Contractors regarding Cooperation with Utilities for relocations, adjustments, and installations of utilities. The Contractor's responsibility is to adequately coordinate, notify, or comply with the Contract and failure to do so shall not form the basis for an extension of Contract Time or additional compensation.

The Contractor shall copy the Project Manager on all communications with utilities. For telephonic communications a summary of the communication shall be provided to the Project Manager monthly.

The Contractor shall be responsible for complying with the New Mexico Excavation Law, NMSA 1978, Section 62-14-1 through -10 which provides the procedures and requirements related to the performance of Project excavation Work.

Failure by the utility owner to relocate, adjust, or install the utility in accordance with the Contract may result in the Project Manager issuing written direction to the Contractor directing that the Contractor shall relocate, adjust, or install the utility per Section 104.2, "Extra Work."

The Contractor shall terminate operations in the immediate area of a utility conflict not identified in the Contract and encountered during the Work. The Contractor shall immediately provide written notice to the Project Manager of the conflict. The Contractor shall continue Work in other areas. The Project Manager shall provide written notification to the Contractor when Work may commence in the area of terminated operations. The Contractor shall make requests for additional Contract Time or compensation per Section 104.3, "Differing Site Condition." Where utility conflicts not identified in the Contract are present, the Contractor shall provide the Project Manager, on a weekly basis, evidence of adequate coordination and cooperation with utilities. Neither additional Contract Time nor compensation will be provided where the Contractor fails to provide the Project Manager, on a weekly basis, evidence including a telephonic log of communications concerning the Contractor's continued cooperation and coordination activities with utilities.

105.7 COOPERATION BETWEEN CONTRACTORS

The Department reserves the right at any time to Contract for and have performed other Work on or near the Project.

When separate Contracts are let within the limits of any one Project, each Contractor shall conduct the Work without interfering or hindering the progress or completion of the Work being performed by other Contractors. Contractors working on the same Project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with the Contract and shall protect and hold harmless the Department for all damages or claims as per Section 107.19, "Responsibility for Third Party Claims and Duty to Defend."

If the Contractor and one (1) or more other Contractors are unable to agree upon the sequence of Work or other matters, the Contractor(s) shall request that the Project Manager

provide a written decision on the issue. The Project Manager will allow a reasonable time for all parties to respond and, after reviewing the information received, will issue a decision binding on all parties within seven (7) Days of receiving such information.

105.8 AUTHORITY AND DUTIES OF THE PROJECT MANAGER

105.8.1 Project Manager Authority

The Project Manager is a designee of the Cabinet Secretary with authority commensurate with that of the Cabinet Secretary and has the following responsibilities:

1. Interpretation and administration of the Contract;
2. Immediate charge of the details of the Project;
3. Authority to reject Work and Material;
4. Authority to wholly or Partially Suspend the Work for reasons beyond the control of the Contractor or not connected to the construction of the Project when the Project Manager deems such a suspension to be in the best interests of the public and the Department; and,
5. Authority to concur with the Contractor's request to Partially Suspend or wholly suspend the Work.

At no cost to the Department, the Project Manager may also wholly or Partially Suspend the Work for cause, including but not limited to, the Contractor's failure to:

- a. Correct unsafe conditions;
- b. Comply with any term or condition of the Contract;
- c. Observe and comply with any Federal or State law or regulation;
- d. Carry out directions of the Project Manager;
- e. Manage its personnel and Subcontractor and its personnel; or,
- f. Perform satisfactory Work.

105.8.2 Contractor Inquiries to Project Manager

The Contractor shall submit all correspondence to the Project Manager. The Contractor shall submit in writing a request for information for any Project issues, including but not limited to discrepancies in the Contract, to the Project Manager who will resolve the issues.

The determination of the Project Manager will be in writing and delivered to the Contractor's Superintendent as soon as reasonably practicable.

105.9 DUTIES OF THE INSPECTOR

105.9.1 Inspector Authority

The Department authorizes its Inspectors to:

1. Inspect the Work;
2. Inspect the preparation, fabrication or manufacture of Materials; and,
3. Notify the Contractor of non-conforming Work, reject non-conforming Materials, and suspend portions of the Work for safety reasons only.

The Contractor shall refer questions at issue to the Project Manager for a decision.

105.9.2 Inspector Authority Limitations

The Department does not authorize its Inspectors to:

1. Alter or waive any provision of the Contract;
2. Issue instructions contrary to the Contract; or,
3. Provide direction, superintendence or guidance to the Contractor, Subcontractors or Suppliers.

Any action or inaction of the Inspector does not waive the Department's right to pursue any and all legal remedies for defective Work or Work performed by the Contractor in an unworkmanlike manner.

105.10 INSPECTION OF WORK

The Contractor shall provide the Project Manager with 48 hour notice for inspection of the Work. Failure by the Contractor to provide the proper notice may result in the Department directing the Work performed without inspection to be removed at no cost to the Department.

The Contractor shall provide the Department or its representative access to the Work and provide all information, Equipment, and assistance requested or required to make a complete and detailed inspection of the Work. All Materials and each part or detail of the Work shall be subject to inspection by the Department.

The Project Manager may direct the Contractor to remove or uncover portions of the finished Work, at any time before Final Acceptance of the Work. The Contractor shall restore the portions of the Work to the standard required by the Contract after the Project Manager's examination. If the examined Work is Acceptable, the Department will pay for the removal and restoration as Extra Work under Section 104, "Scope of Work," and Section 109.5, "Payment for Changes, Differing Site Conditions, and Extra Work." However, if the examined Work is unacceptable, the Contractor shall remove and restore the Work at no additional cost to the Department.

Action or inaction by a Department Inspector shall not relieve the Contractor from any responsibility under the Contract for Acceptable Work in conformity with the Contract. The failure to properly perform inspections, tests or approvals by the Department shall not relieve the Contractor from its obligation to perform the Work in strict conformance with the Contract.

The Department may allow a unit of government, political subdivision, or a railroad corporation to inspect the Work. This inspection shall not make the unit of government or political subdivision or the railroad corporation a party to the Contract and shall not interfere with the rights of either party.

105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK

Work that does not conform to the requirements of the Contract shall be unacceptable, unless it is determined by the Project Manager to be Acceptable under the provisions of Section 105.3, "Compliance with Plans and Specifications."

Should any defective Work or Material be discovered, before Final Acceptance, the Department will issue a non-conformance in accordance with Section 109.8.2, "Non-Conformance."

Prior to Department Acceptance, the Contractor shall replace or repair Materials damaged in transit or during handling at no additional cost to the Department.

The Contractor shall remove unacceptable Work resulting from causes existing before the Final Acceptance of the Work and replace in an Acceptable manner at no additional cost to the Department. The Project Manager will set the time limit for the replacement Work.

The Department shall not pay for the following under the provisions of the Contract:

1. Work performed contrary to the Project Manager's direction or as provided in the Contract;
2. Work performed beyond the lines and grades on the Plans; or,
3. Work performed without authority.

Upon failure of the Contractor to comply with the removal and replacement of unacceptable or unauthorized Work within the time specified by the Project Manager, the Project Manager shall have authority to cause unacceptable Work to be removed and replaced. The Project Manager will then deduct from the monies due or that become due to the Contractor the cost of removing or replacing the unacceptable or unauthorized Work.

105.12 LOAD RESTRICTIONS

The Contractor shall observe legal load restrictions when hauling Equipment or Material on public Roads outside of the Project or on Roadways within the Project. The Project Manager may approve exceptions, in writing, provided the Contractor has obtained the proper oversize and overweight permits. The Contractor is liable for damage that may result from moving Equipment, even with the issuance of a special permit.

The Contractor shall not use Equipment or haul loads that will cause damage to Structures, Roadway, or any other construction, regardless of legal load allowances.

If the Project Manager determines that anticipated hauling operations may cause damage to existing Roadways or Structures, the Project Manager will issue a written notice to the Contractor. Within seventy two (72) hours of the notice, the Project Manager will elect one (1) or more of the following solutions:

1. Change the haul route; or,
2. Reduce the allowable load limit.

If the Project Manager determines that hauling operations are causing damage to existing Roadways or Structures, the Project Manager will issue a written notice to stop operations causing the damage. Within seventy two (72) hours of the notice, the Project Manager will issue written direction to the Contractor to repair the damage or the Project Manager will elect one(1) or more of the following solutions:

1. Change the haul route;
2. Reduce the allowable load limit; and/or,
3. Allow the operations to continue with the requirement that the Contractor repair all damaged areas at ½ Unit Bid prices. In the absence of a Unit Bid price, the current published average unit bid prices shall be used.

105.12.1 Corrective Actions and Methods of Payment

105.12.2 Change in Haul Route

If the Project Manager changes the haul route, the Department will modify the Contractor's payment per the following equation:

$$P = R \times t \times (d_1 - d_0) \quad (1)$$

Where,

- P is the payment modification (in dollars)
- R is the rate (in dollars per ton mile determined in accordance with Section 109, "Measurement and Payment.")
- t is the weight of Material hauled from the new stockpile area (in tons)
- d_0 is the original haul distance measured from the Roadway access point to the original stockpile area
- d_1 is the new haul distance measured from the Roadway access point to the new stockpile area

105.12.2.1 Change in Allowable Load Limit

If the Project Manager reduces the allowable load limit, the Department will pay the Contractor in accordance with the following equation:

$$P = \frac{QF \times R \times d \times (LA - LR)}{LA} \quad (2)$$

Where,

- P is the additional payment (in dollars)
- R is the rate (in dollars per ton mile determined in accordance with Section 109, "Measurement and Payment.")
- QF is the total quantity of Material hauled at the reduced load limit (in tons)
- LA is the allowable load limit (in tons)
- LR is the reduced load limit (in tons)
- d is the haul distance (in miles)

If the Project Manager allows operations to continue or because of damage to an existing Roadways or Structures, the Department will pay the Contractor for the Material used to make the repairs at the ½ of the Bid Item Unit Price, or in accordance with Section 109, "Measurement and Payment." If an item is not part of the Contract, the Department will negotiate a new unit price. If a Structure or existing Roadway must be repaired, the Department may pay the Contractor for hauling repair Materials using a rate requested and justified by the Contractor and approved by the Project Manager.

105.13 RESERVED

105.14 RESERVED

105.15 MAINTENANCE DURING CONSTRUCTION

The Contractor shall maintain the Work during construction and until the Department Accepts the Work, except as otherwise provided in Section 104.5, "Maintenance of Traffic," and Section 105.18, "Acceptance." This maintenance shall consist of continuous, daily Work

with adequate Equipment and forces so that the Roadway and Structures are kept in satisfactory condition. The Contractor shall be responsible for maintaining the Project free and clear of Deleterious Materials including debris, weather related remnants, snow, loose Materials and trash. The Department will be responsible for snow removal operations on travel lanes open and utilized by the public.

The Contractor shall maintain the previous course and Subgrade when the Plans require the Contractor to place traffic on the unfinished Roadway.

All maintenance Work during construction and before the Project is Accepted shall be Incidental. The Department shall not pay the Contractor an additional amount for this Work except in accordance with Section 104.5, "Maintenance of Traffic," and Section 105.18, "Acceptance."

105.16 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE

If the Contractor fails to maintain the Project in accordance with Section 105.15, "Maintenance During Construction," the Project Manager shall notify the Contractor in writing of the failure. If the Contractor does not take corrective action in timeframe specified by the Project Manager, the Project Manager may issue a written notice per Section 109.8.2, "Non-Conformance" or notice of the Contractor's apparent default per Section 108.9, "Default of Contract."

If the Contractor does not begin maintenance after notice from the Project Manager, the Project Manager may begin maintenance of the Project. For corrective actions implemented by the Project Manger the Contractor shall reimburse the Department for Department incurred costs of such maintenance plus an additional ten percent (10%) for administrative costs.

105.17 RESERVED

105.18 ACCEPTANCE

105.18.1 Partial Acceptance

The Contractor may request in writing that the Project Manager inspect a portion of the Project (e.g., a Structure, a section of Road, etc.) at any time during the Work. If the Project Manager finds that portion to be in accordance with the Contract, the Project Manager may Accept that portion as complete, and, without waiving the provisions in Section 105.3, "Compliance with Plans and Specifications," Section 107.26, "No Waiver of Legal Rights" and Section 109.10, "Project Closure" the Contractor may be relieved of further responsibility for that portion unless the Department discovers latent defects before Final Acceptance of the Work. Such partial Acceptance does not void or alter the Contract.

The Department will Accept permanent traffic safety and control devices installed in accordance with the Contract (with all ancillary components) and being used by the public upon installation but before completion of the remaining Work.

Permanently installed items Accepted on this basis are limited to the following:

1. Guardrail;
2. Impact attenuators;
3. Traffic Signals;
4. Signs;
5. Lighting;

6. Raised pavement markers;
7. CWB;
8. Concrete Bridge parapet;
9. Bridge railing;
10. Post and cable barrier ;
11. Guardrail anchorages;
12. Permanent pavement markings; and,
13. Fence.

All required performance tests and guarantees shall remain applicable.

The Contractor shall repair or replace any damage, theft, or vandalism to these items after Acceptance in accordance with Section 104.2, "Extra Work." The Contractor shall repair or replace items damaged due to the Contractor's negligence or as a result of the Contractor's failure to protect the Work per Section 107.20, "Contractor's Responsibility," at no additional cost to the Department.

The Contractor shall erect these items in a logical construction sequence. The Department shall not Accept prematurely constructed items until they may be used for their intended purposes.

105.18.2 Final Acceptance

The Department will make the Final Acceptance in accordance with Section 109.10.8, "Physical Completion, Release of Retainage, Final Payment and Final Acceptance."

105.19 NOTICE OF INTENT TO CLAIM

Notice of intent to claim shall be given in order that the Department can assess the situation, make an initial determination as to the causes of the intent to claim, institute appropriate changes or procedures to resolve the matter, document issues related to the intent to Claim, track costs and possible Delay, and facilitate resolution of the intent to Claim. The failure of the Contractor to provide a timely and complete Notice of Intent to Claim form, a contemporaneous statement of estimated damages or Delay, and to comply with the other requirements of this section shall constitute a waiver or abandonment of the Claim.

The Contractor's submission of the Notice of Intent to Claim form and the Project Manager's actions related to the Notice of Intent to Claim shall not be construed to prove or validate the Claim or be construed as an admission of liability.

1. Unless otherwise specified by the Contract, the Contractor shall only make Claims in accordance with the exclusive administrative remedy and procedures set forth in this Section and Section 105.20, "Administrative Remedy."
2. The Contractor shall submit to the Project Manager its notice of intent to claim on the Department's current Notice of Intent Claim form. The Notice of Intent to Claim form and documents or information submitted with the same shall constitute the Contractor's intent to make a Claim. The notice of intent to claim shall provide a contemporaneous statement of estimated damages or Delay before beginning the Work on which the Claim is based, but, in no event shall notice be given later than seven (7) Days of the Contractor discovering the condition or issue giving rise to the Claim, or within seven (7) Days of receipt of a notice of a differing site condition from the Project Manager. A notice of intent to Claim shall include, when relevant to the

intended Claim (e.g., when the Contractor intends to seek a Contract adjustment for time, Delay damages, or reduction in Liquidated Damages, etc.), a revised schedule that identifies the impacts pursuant to Section 108.3.2, "Schedule Format;" failure to include a revised schedule shall render the notice of intent to Claim incomplete. This Section and the deadlines stated herein do not modify any of the deadlines for submitting revised schedules as provided in Section 108.3, "Schedule."

3. If the Contractor submits a timely Notice of Intent to Claim Form the Project Manager may, without admitting liability for the Claim, direct the Contractor to keep a complete and accurate account, in detail, of the cost of doing the Work on a Force Account basis per Section 109.6, "Force Account." Failure to maintain records on a Force Account basis when so directed by the Project Manager shall waive any associated Claim by the Contractor.
4. The Contractor shall provide the Project Manager proper facilities to keep account of the actual cost associated with the notice of intent to claim; the Contractor waives the right to assert a Claim if the Project Manager is not afforded proper facilities to keep account of actual cost. The Project Manager may, in the Project Manager's discretion, in writing, waive this requirement to keep account of actual cost upon a showing of adequate justification by the Contractor.
5. If the Project Manager finds that the notice of intent to claim is justified the Project Manager will process a Supplemental Agreement to resolve the notice of intent to claim.
6. If the notice of intent to claim is unresolved then the Contractor shall comply with Section 105.20, "Administrative Remedy."

105.20 ADMINISTRATIVE REMEDY

This Section governs the administrative remedy procedure to resolve all Claims, unless otherwise specified in the Contract. The administrative remedy procedure is the sole Contractual procedure to resolve Claims. No Claim shall be accorded any level of review unless the procedure below is followed sequentially. The sequential steps of the process are as follows:

- Step I. Notice of Intent to Claim;
- Step II. Submittal of the Claim to the Project Manager;
- Step III. District Engineer review and decision;
- Step IV. Service of Request for Reconsideration of Claim to Cabinet Secretary;
- Step V. Cabinet Secretary's review, which may include referral to Claims Board for an informal hearing, and Cabinet Secretary's decision; and,
- Step VI. Service of Request for Arbitration or Service of Summons and Complaint in State District Court.

The Contractor shall not proceed to the subsequent step without a written determination from the preceding step.

The complete terms of a resolved Claim, regardless of the level of the administrative remedy, shall be documented and memorialized via a Change Order executed by the Contractor and the Department. The executed Change Order shall represent a final agreement to the total additional compensation and time due for any and all Work and items pertaining to the Work associated with the Change Order. Unless otherwise provided in the terms of the Change Order, the executed Change Order shall operate as an accord and satisfaction of the Claim and shall operate as a bar to any further Claim by the Contractor. Each party shall bear its own attorneys' fees, costs, and expert fees.

Step I. Notice of Intent to Claim, See Section 105.19, "Notice of Intent to Claim:"

The Department shall dismiss a Contractor's Claim for failure to comply with the time limitations, requirements and procedures set forth in this Section and Section 105.19, "Notice of Intent to Claim."

105.20.1 Submittal of the Claim to the Project Manager

Step II. Submittal of the Claim to the Project Manager:

The Contractor shall submit its Claim on the Department's Claim Form. The Project Manager retains the right to request additional information and documents from the Contractor to support the Claim. The Contractor shall provide the requested additional information and documents.

1. A Claim shall be rejected and it shall constitute a waiver or abandonment of the Claim and a failure to exhaust its administrative remedy for the Contractor's failure to comply with the following conditions:
 - a. The Claim shall be in writing;
 - b. The Claim shall be submitted on the Department's Claim Form;
 - c. The Claim shall be submitted within 30 Days of the date that the Work associated with the Claim has been completed;
 - d. The Claim shall be submitted only once;
 - e. The Claim shall include all required supporting documentation and information; and
 - f. A Contractor's, Subcontractor's or Supplier pass-through Claim shall be certified by the Contractor as the Contractor's Claim on the Department's current approved forms.
2. The Contractor has the burden of fully justifying and documenting the Claim and shall provide to the Project Manager the following supporting documentation and information in support of the Claim. The following supporting documentation shall also be updated from those documents submitted with the Notice of Intent to Claim:

The Contractor has the burden of fully justifying and documenting the Claim and shall provide to the Project Manager the following supporting documentation and information in support of the Claim. The following supporting documentation shall also be updated from those documents submitted with the Notice of Intent to Claim:

 - a. Description of the issue upon which the Claim is based;
 - b. Location where the issue arose;
 - c. The dates impacted including the time and date the issue arose;
 - d. Clear explanation of why the issue requires additional compensation or time or a change to the Contract, including references to the relevant portions of the Contract;
 - e. Copies of all written communications including correspondence and emails related to the issue;
 - f. A detailed compilation of the amount of additional compensation sought and a breakdown of the amount sought as follows: documented additional job site labor expenses; documented additional cost of Materials and supplies; a list of additional Equipment costs claimed, including each piece of Equipment and the

Blue Book rental rate claimed for each; any other additional direct costs or damages and the documents in support thereof;

- g. Where a Claim seeks additional time, time and compensation for Delay, adjustment of Contract Time, or the reduction or elimination of liquidated damages, previously submitted Baseline Schedule and revised schedules that comply with the requirements of Section 108.3, "Schedule";
- h. Invoices identifying the labor, Materials, and Equipment used or proposed to be used;
- i. Project Cost Reports. If the amount claimed by the Contractor exceeds \$100,000.00, Project cost reports for the time periods relevant to the Contract and the performance of the Work;
- j. Bid Documents. If the amount claimed by the Contractor exceeds \$100,000.00, or if required by the Contract the Contractor shall make the Contractor's documents available for inspection by the Project Manager at the Contractor's Project office. This includes information and calculations used to prepare and determine its Bid for the Contract prior to submission of the Bid. The required bid preparation documents, as maintained by the Contractor, to be produced shall include: clear itemization of the costs for each pay item broken down into components sufficient to allow a detailed cost estimate; the costs allocated to each component broken down into the Contractor's usual estimate categories such as direct labor, Equipment, Materials, and Subcontractor cost; indirect costs, including the indirect cost allocations made to each bid item; quantity takeoffs; the construction and progress schedule and any conceptual schedules upon which the Bid was based; rates of production and progress; marked up plans, sheets and Working Drawings ; calculations, copies and quotes from Subcontractors and Suppliers; memoranda, narratives, and all other information used by the Contractor to arrive at all of the prices contained in the Bid. The Project Manager may waive this requirement;
- k. Total amount of the Claim in terms of time and compensation; and,
- l. Certification of Claim. The Contractor shall submit a Certification of Claim form with the Claim.

105.20.2 District Engineer

Step III. District Level Review and Decision:

The District Engineer or designee has 30 Days from the date the Claim is received by the Project Manager, or additional time if agreed upon by both parties in writing, to review and render a decision. If the District Engineer or designee does not make a written decision within the 30 Days, or the agreed upon additional time, the Claim is deemed denied by the District Engineer. The parties may engage in informal mediation to resolve the Claim at the District level prior to the expiration of the time in which the District Engineer or its designee may render a decision.

Once a Claim is submitted to the Project Manager, nothing in this section shall be construed as permitting the Contractor to revive, modify, supplement, enlarge, or amend the Claim or the basis of entitlement other than providing additional documents and information in support of the Claim. All further proceedings shall be limited solely to the bases of entitlement and the amount of any compensation or time stated for any and all issues claimed in the Contractor's written Claim submitted.

105.20.3 Secretary Level

Step IV. Service of Request for Reconsideration of Claim to the Cabinet Secretary:

The Contractor shall within ten (10) Days of the District Engineer's decision, serve a written request to reconsider the Claim. When the Contractor fails to request reconsideration to the Cabinet Secretary within the ten (10) Day timeframe then the District Engineer's decision is deemed Accepted by the Contractor. This Acceptance shall constitute a complete and final resolution of the Claim and the Department will, within 30 Days of the District Engineer's decision, execute a unilateral Change Order implementing the District Engineer's decision.

A request for reconsideration of the Claim shall be rejected and it shall constitute a waiver or abandonment of the Claim and a failure to exhaust its administrative remedy for the Contractor's failure to comply with the following conditions:

1. Service of Process at the Secretary Level. Service shall not be considered effective unless the request includes all supporting documentation provided at the District Level and, when applicable, a copy of the District Engineer's written denial of the Claim. Service of all notices and required documentation and information at the Secretary Level shall be made upon the Cabinet Secretary with a copy contemporaneously transmitted to both the District Engineer and the Department's Office of General Counsel. Service upon the Cabinet Secretary shall be made during the Department's regular Business Hours by delivery in person, or by certified mail, postage prepaid, return receipt requested, or by delivery by a nationally recognized overnight or same-day courier service that obtains receipts. The copy contemporaneously transmitted to the Office of General Counsel may be served by the means for serving the Cabinet Secretary or, with prior written agreement of the Office of General Counsel, by facsimile copy or by email transmission. Service of notice or documents made after the Department's regular Business Hours shall not be effective until the next business Day. Service upon the District Engineer may be made by the means for serving the Cabinet Secretary or by facsimile copy or by email transmission and need not include the documentation previously submitted at the District level.
2. Certification of Claim. The Contractor shall submit a Certification of Claim with the request for reconsideration on the Department's approved form.

Additional Information. The Secretary retains the right to request additional information from the Contractor to support the Claim, regardless of the Project Manager's previous waiver.

Step V. Cabinet Secretary's Review, Which May Include Referral to Claims Board for an Informal Hearing and Cabinet Secretary Decision:

1. The Cabinet Secretary will provide a written decision on the Claim or will refer the Claim to the Department's Claims Board within 21 Days of service of the request for reconsideration. This deadline may be extended in writing by the Cabinet Secretary.
2. Claims Board. If the Claim is referred to a Claims Board, an informal dispute resolution board, by the Cabinet Secretary, the Secretary shall appoint up to three (3) independent panelists with relevant experience in highway and transportation design, construction management, engineering, surveying, construction Contract administration, construction oversight Work, or law. The Claims Board shall not include any current employees of the Department or the Contractor, but may include individuals contracted to provide services to the Department. The Claims Board shall apply the Contract to the Claim and shall conduct an informal hearing in order to facilitate the expeditious and informal resolution of the Claim. Attorneys

representing the parties are permitted to attend the informal hearing; however, attorneys shall not participate in the informal hearing unless the Claims Board specifically addresses an issue to them or unless agreed to by both parties. Notification shall be provided by both parties a minimum of five (5) Days prior to the hearing if legal representation will be attending the hearing. The Claims Board shall issue a final, written recommendation to the Cabinet Secretary to resolve the Claim.

3. **Secretary Decision.** If the Claim is referred to the Department's Claims Board, the Cabinet Secretary will provide a written decision within 21 Days of the Secretary's receipt of a final, written recommendation on the Claim from the Claims Board; If the Cabinet Secretary does not provide a written decision within 21 Days, unless extended by the Secretary in writing prior to expiration of time to issue a decision, the Claims Board's recommendations shall be deemed to have been adopted by the Cabinet Secretary and shall operate as the Secretary's decision.
4. **Payment.** The Contractor is only entitled to payment of its Claim pursuant to the Cabinet Secretary's decision if the Contractor fully Accepts the decision and executes an accompanying Change Order. If the Contractor fails to execute a Change Order within 21 Days of the Cabinet Secretary's decision, the Department may process a unilateral Change Order implementing the Cabinet Secretary's decision. The Contractor's proceeding with litigation in State District Court or arbitration shall operate as a waiver by the Contractor to recover or receive payment pursuant to the Cabinet Secretary's decision.

105.20.3.1 Arbitration

Step VI. Service of Request for Arbitration or Service of Summons and Complaint in State District Court:

1. The Contractor and Department may agree to arbitrate the Claim instead of proceeding to litigation in State District Court. Arbitration may only be had at the mutual agreement of the Contractor and the Department. Arbitration shall be conducted in accordance with the New Mexico Uniform Arbitration Act (NMSA 1978, § 44-7A-1, et seq.) and this Section.
2. Service of the request to arbitrate the Claim by the Contractor shall only be made in the request for reconsideration. The Cabinet Secretary will issue a decision denying or agreeing to the request for arbitration in writing within ten (10) Days of the receipt of the request to arbitrate. If the Cabinet Secretary does not respond to the request to arbitrate then the request is deemed denied.
3. By the parties agreeing to arbitration, the Contractor waives the right to redress through litigation filed in State District Court. The Contractor's proceeding with arbitration shall operate as a waiver by the Contractor of recovery under any written decision issued by the Cabinet Secretary.
4. If the Contractor and Department agree to arbitrate the Claim the arbitration panel shall consist of three (3) members.
5. Within 15 Days of the agreement to arbitrate the Claim, the Contractor shall submit the name of a panelist. The Contractor's panelist shall:
 - a. Not be an employee of the Contractor;
 - b. Have 15 years' experience in Highway construction management, methods, techniques, or law; or have an active professional license with the state of New Mexico as an Engineer, Surveyor or Attorney with ten (10) years' experience in Highway construction management, methods, techniques, or law;
 - c. Be either a resident of the state of New Mexico or identify New Mexico as the panelist's principal place of business; and,

- d. Agree to serve on the panel;
6. Within 15 Days of receiving notice of the Contractor's panelist, the Cabinet Secretary shall submit the name of a panelist. The Cabinet Secretary's panelist shall:
 - a. Not be an employee of the Department, but may include individuals contracted to provide services to the Department;
 - b. Have 15 years' experience in Highway construction management, methods, techniques, or law; or have an active professional license with the state of New Mexico as an Engineer, Surveyor or Attorney with ten (10) years' experience in Highway construction management, methods, techniques, or law;
 - c. Be either a resident of the state of New Mexico or identify New Mexico as the panelist's principal place of business; and,
 - d. Agree to serve on the panel;
7. Within 30 Days after the Cabinet Secretary panel appointment, the two (2) panelists will choose a third panelist. The third panelist shall:
 - a. Be a professional arbitrator who is a member or diplomat of a nationally recognized professional arbitration organization, such as the National Academy of Arbitrators or the American Arbitration Association; or is a retired federal or New Mexico district or appellate judge; or be a former employee of FHWA;
 - b. Not be an employee or a contractor of either the Department or the Contractor; and,
 - c. Agree to serve on the panel;
8. If the two (2) panelists are unable to agree, a district judge from the First Judicial District shall choose the third panelist from a list of four (4) prospective panelists who meet the requirements of the preceding paragraph, two (2) each provided by the Department and the Contractor. Application to the court for this appointment shall be made by either or both parties within 15 Days of the impasse; the parties may agree in writing to extend this deadline.
9. The panel shall hold the arbitration hearing in Santa Fe County, unless otherwise approved by the Department, no later than 90 Days after the panel is selected. If the panel fails to meet this deadline or if the parties agree to extend the deadline, the panel retains jurisdiction to hear and resolve the issues in dispute.
10. Each party will pay the expenses and fees of its chosen panelist and attorney. Both parties will share equally the expenses and fees of the third panelist. If both parties agree, they will share court reporter costs. If not, the party requesting the transcription will pay the full cost.
11. The proceedings and the decision of the panel will be in accordance with the New Mexico Uniform Arbitration Act, NMSA 1978, § 44-7A-1 et seq. The decision is final and binding and may be vacated, confirmed, or appealed only in accordance with the New Mexico Uniform Arbitration Act (NMSA 1978, § 44-7A-1 et seq.).

105.20.4 Litigation

If the Contractor does not accept the Cabinet Secretary's decision the Contractor shall issue its notice of Public Works Mediation within three (3) Days of the Cabinet Secretary decision. The Contractor shall provide no less than seven (7) Days' notice of the convening of a mediation session. The Public Works Mediation shall be complete within thirty (30) Days of the date of the notice of Public Works Mediation. No extensions of this timeframe will be granted unless approved by the Department. Service of notice of a mediation session shall be made upon both the Cabinet Secretary and the Office of General Counsel and shall otherwise

comply with the New Mexico Public Works Mediation Act. The Contractor shall exhaust the mandatory mediation procedures of the New Mexico Public Works Mediation Act (NMSA 1978, § 13-4c-1, et seq.) before seeking judicial relief in State District Court. Failure to timely notice and convene a mediation session and to timely file and serve a summons and complaint shall operate as a waiver and abandonment of Contractor's Claim, shall act as an Acceptance of the Cabinet Secretary's decision, and shall bar the Contractor from proceeding to litigate the Claim.

The Contractor may, within 45 Days of the issuance of the Secretary's decision, proceed with litigation in State District Court by filing a summons and complaint. The Contractor shall properly serve the summons and complaint within 30 Days of the filing of the Complaint in State District Court. Upon expiration of the time in which to mediate and file a summons and complaint, or if a summons and complaint has been filed the expiration of the time in which to properly serve the summons and complaint, the Department may process a unilateral Change Order implementing the Cabinet Secretary's decision based on the Contractor's abandonment or waiver of its Claim.

SECTION 106: CONTROL OF MATERIALS

106.1 CONTRACTOR-FURNISHED AGGREGATE AND BORROW SOURCES

Exploration and development of Material sources by the Contractor including related GRT and Tribal Taxes shall be Incidental.

The Contractor shall notify the Project Manager in writing of the Materials source prior to delivery of aggregate or borrow Materials to the Project. The Contractor shall provide Acceptable Materials and shall provide the following documentation to the Project Manager:

1. Location of source;
2. Copies of lease agreements, purchase orders, or Pit Agreements the Contractor has made with the pit owner or Supplier;
3. Evidence of environmental Acceptability, which includes the completed environmental and Cultural Resource requirements of Section 107.14.1, "Environmental and Cultural Resource Studies and Approvals." Such evidence shall, where appropriate include the completed and Department Accepted recommendations for environmental and Cultural Resource management. Plans for restoration, including contouring and re-vegetation if necessary; and,
4. Testing results from a Department-approved Laboratory.

Upon request in writing from the Contractor, the Project Manager may approve Materials at the source prior to delivery. The Project Manager may reject sources, or specific areas within sources, due to failure to provide Acceptable Materials or due to environmental, social, or cultural concerns. If the Project Manager determines that the sources of previously Acceptable Materials do not produce Acceptable Materials, the Contractor shall provide Acceptable Materials from other sources, or make changes to the existing source to provide Acceptable Materials. No additional compensation or time shall be provided to the Contractor for unacceptable Materials or for developing alternate source locations.

The Project Manager will notify the Contractor in writing within ten (10) Days if its Material source is Acceptable.

106.2 SUPPLIER PLANT INSPECTION

The Department may inspect Materials at the Supplier's plant. In this event, the Contractor shall:

1. Cooperate and ensure the cooperation of its Materials Supplier;
2. Guarantee unrestricted entry (at reasonable times) to areas where the relevant Material is being manufactured or produced;
3. Arrange for the necessary facilities to be adequately inspected for the production or fabrication of the Material; and,
4. Ensure adequate safety measures are implemented for the inspection.

The Department may retest Materials, before or during use in the Work, and reject Materials that, when retested, do not meet the requirements of the Contract, even if the Materials were tested and Accepted at the plant.

106.3 SAMPLES, TESTS, AND CITED SPECIFICATIONS

The Department will perform tests in accordance with standards, methods, or Specifications, of the Project's Contract. Unless otherwise specified in the Contract, the

Department will take samples and perform tests at its own expense. Unless otherwise specified in the Contract, the Department will provide test results to the Contractor.

106.4 CERTIFICATES OF COMPLIANCE

The Contractor shall submit Certificates of Compliance forms to the Project Manager before installing or incorporating Material in the Work, and shall ensure each Certificate of Compliance contains all information in the Department current approved Certificate of Compliance form. Additionally, documentation required to verify the information on the Certificate of Compliance form shall be submitted with the completed Certificate of Compliance form.

Materials inspected and stamped during the manufacturing process by a representative of the Department will require the Certificate of Compliance form.

The Contractor may provide Material purchased in bulk or left over from previous Projects by submitting Certificates of Compliance forms for those Materials.

Unless otherwise stated in the Contract, Materials not permanently incorporated into the Work will not require a Certificate of Compliance form.

Unless requested in writing by the Project Manager, electric items meeting UL approval and underground utility Materials meeting ASTM or AWWA Specifications that are so certified or stamped will not require a Certificate of Compliance form.

106.5 FOREIGN MATERIALS

Unless otherwise specified in the Contract, the Contractor shall deliver Materials manufactured outside the United States to approved locations within the state, where they shall remain until sampling and testing are complete. The Contractor shall arrange for testing that the Department is not able to perform, at no additional cost to the Department, and shall test foreign Materials within the state in the presence of the Department.

The Contractor shall provide a Certificate of Compliance for each lot of foreign Material in accordance with Section 106.4, "Certificates of Compliance;" and, if required, provide with the Certificate of Compliance, certified MTRs for each lot, and clearly identify to which lot they apply.

For structural Material, the Department will only Accept Material from foreign and domestic manufacturers that have established adequate in-plant Quality Control to the satisfaction of the Project Manager. The Department will not Accept structural Materials that do not have Certificates of Compliance and MTRs.

The Project Manager may inspect the plant or require the Contractor to submit detailed written proof of adequate Quality Control.

106.6 STORAGE OF MATERIALS

The Contractor shall request from the Project Manager written approval to store Equipment or Materials within the ROW for the adequate execution of the Work. The Contractor shall store Equipment and Materials to preserve quality and fitness, to protect against vandalism or theft, and to facilitate inspection. The Contractor shall be responsible for the replacement or repair of Materials affected by inadequate protection.

106.7 HANDLING AND TRANSPORTING MATERIALS

The Contractor shall handle Materials in a manner that preserves the Acceptability for the Work. The Contractor shall ensure the transportation of Materials is in accordance with state and federal regulations, and prevent leakage of, scattering of, or damage to Materials. Materials damaged or lost in transportation shall be deemed unacceptable and are not subject to payment by the Department.

106.8 DEPARTMENT-PROVIDED MATERIALS

Material provided by the Department will be made available to the Contractor as specified in the Contract. The Contractor will be held responsible for all Department supplied Material when it takes physical possession of the Materials and until such time that the Materials are incorporated into the Work and Accepted.

106.9 MATERIALS DESIGNATED BY TRADE NAME

The Contract may require Materials or Equipment by trade or manufacturers' names. The Department will not Accept the substitution of Materials or Equipment when the Contract requires Materials or Equipment of specific trade or manufacturers' names.

106.10 EQUIPMENT AND MATERIAL GUARANTEES AND WARRANTIES

The Contractor shall obtain and assign to the Department manufacturer and producer guarantees or warranties for Materials and Equipment. The Contractor shall warrant, for six (6) months after Material or Equipment is installed and operational, that mechanical and electrical Equipment without a manufacturer or producer guarantee are free from defects or imperfections in workmanship and Materials. The Contractor shall repair malfunctions or defects that develop during the six-month period.

The Contractor shall supply manuals for Equipment incorporated in the Work providing the following information:

1. Operational procedures;
2. Complete nomenclature;
3. Wiring diagrams;
4. Schematics showing test voltage and procedural methods;
5. Functional description of circuits;
6. Parts lists;
7. Cross-references to standard part numbers;
8. Names and addresses of sources for testing procedures where appropriate
9. Flow diagrams; and,
10. Other relevant data.

106.11 SAFETY DATA SHEETS (SDS)

The Contractor shall submit to the Project Manager the most current SDSs for all Materials that require SDSs upon delivery of the Materials to the Project. The SDS shall conform to current Federal requirements in 29 C.F.R. § 1910.1200 (g).

106.12 BUY AMERICA REQUIREMENTS

The Contractor shall provide Materials in accordance with the Buy America Requirements in 23 C.F.R. § 635.410 on federal-aid Projects.

The Contractor shall bear the burden of proof and the cost to show the origin and place of manufacture of iron and steel products and Materials.

SECTION 107: LEGAL RELATIONS, ENVIRONMENTAL REQUIREMENTS, AND RESPONSIBILITY TO THE PUBLIC

107.1 LAWS TO BE OBSERVED

Before the start of Work, the Contractor shall be fully informed and make the necessary contacts with municipal and state agencies concerning obligations related to all applicable federal and state laws, all local laws, ordinances and regulations, and all orders and decrees of bodies or tribunals having jurisdiction or authority. The Contractor, Subcontractors, and Suppliers shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and protect and indemnify the State and its officers, employees and agents against all Claims or liability arising from or based on the violation of such laws, ordinances, regulations, orders, or decrees, by the Contractor, its officers, employees or agents, Subcontractors or Suppliers.

107.2 PERMITS, LICENSES, AND TAXES

The Contractor shall procure all permits and licenses; pay charges, fees, royalties, and appropriate taxes; and give notices necessary and incidental to the lawful performance of the Contract.

Prior to beginning Work the Contractor shall furnish to the Department a written list of all permits required for the proper completion of the Contract. The list shall clearly identify the type of permit or permits that must be obtained before Work can be started. Copies of fully executed permits shall be furnished to the Department upon request.

107.2.1 COMPLIANCE WITH PAYMENT OF TAXES

The Contractor shall pay all lawful taxes imposed by the state of New Mexico or other political entities.

The successful Bidder, after receiving the Notice of Preliminary Award of Contract, shall provide to the Department both the Bidder's Taxation and Revenue Department tax identification number and the Bidder's Motor Transportation Division account number. If either of these numbers is unavailable, the Contractor shall submit a letter of explanation. A Notice to Proceed will not be issued until the Contractor submits both; numbers or a satisfactory letter of explanation.

107.2.2 GROSS RECEIPTS, INDIAN BUSINESS ACTIVITY, AND TRIBAL EMPLOYMENT RIGHTS ORGANIZATION TAXES

107.2.3 New Mexico Gross Receipts Tax

The Department will pay the Contractor for applicable New Mexico GRT and local option tax (including tax increases or decreases effective after the Contract date), and the Contractor shall pay applicable taxes to New Mexico Taxation and Revenue Department. The Contractor shall show the GRT and local option tax as a separate amount added to each request for payment.

The Department shall be promptly reimbursed or repaid for any tax, including GRT, that is refunded to the Contractor, including any refund received by the Contractor after final payment, to the extent such tax was paid by the Department to the Contractor. The Contractor shall keep and maintain all documents, applications for tax refund, and forms filed with, submitted to, received from, or required by the New Mexico Taxation and Revenue Department which relate to the payment or refunding of any tax paid pursuant to this Section

for five (5) years following final payment. All of the above Material shall be made available to the Department or FHWA for review, audit, inspection, and copying and shall be produced, upon request, at the Department General Office, the District in which the Work was performed, or an FHWA office, as directed.

107.2.4 Tribal Taxes

All Bids submitted shall exclude any tribal business tax, TERO tax, and other tax imposed by a tribal government. The Department will pay the tax or will exercise its prerogative to challenge the tribal government's authority to impose the tax. If the Department exercises its prerogative to challenge the tribal government's authority to impose the tax, the Department will reimburse the Contractor for such tax only if a court of competent jurisdiction rules the tribe has authority to impose the tax. The Department will reimburse the Contractor only if the final decision of the litigation, or other final disposition of the litigation, results in a determination that the tribe has jurisdiction to impose the tax. The Department will be subrogated to the rights of the Contractor to Claim a refund of, or to contest, any such tax imposed on the Work to the extent any alleged obligation of the Contractor or the Department to pay such tax arises under this section or through the Contractor's performance of this Contract.

The Department will reimburse the Contractor for payment of any Tribal Tax directly related to the performance of the Work within the Project imposed by a tribe upon tribal verification that the tax was paid by the Contractor.

107.5 PATENTED DEVICES, MATERIALS, AND PROCESSES

The Contractor's Bid Item Unit Price shall include the cost of all royalties and costs from patents, trademarks and copyrights needed to complete the Work.

If the Contractor employs any design, device, Material, or process covered by letters of patent, copyright or trademark, the Contractor shall secure approval for its use from the patentee or owner. The Contractor and the Surety shall indemnify and save harmless the Department from all Claims (including costs, expenses, and damages the Department may be obligated to pay) for infringement by reason of its use. The Contractor and Surety shall also indemnify and save harmless any affected third party and any political subdivision from all claims for infringement by reason of its use.

107.6 RESTORATION OF SURFACES OPENED BY PERMIT

The Department reserves the right to allow utility services with authorized permits by the Department to enter the Project and perform the permitted Work.

When directed by the Department the Contractor shall make all necessary repairs. If directed by the Department, the repairs will be subject to the same requirements as the original Work performed. The Department will pay for such repairs in accordance with Section 109.5, "Payment for Extra Work."

The Department will address time extension requests due to Work by utility services in accordance with Section 108.6 "Determination and Extension of Contract Time."

107.7 FEDERAL AID PROVISIONS

When the FHWA or other federal agency is obligated to reimburse the Department for all or any portion of the cost of a Project, the Contractor shall observe and be subject to federal law applicable to such reimbursement. In such situations, federal requirements supersede conflicting provisions of state and local laws, rules, or regulations. The Work shall be subject

to inspection and oversight by the appropriate federal agency. Such inspection or oversight shall not make the U.S. Government a party to this Contract, nor shall the U.S. Government interfere with the rights of the Contract parties.

107.8 SANITARY, HEALTH, AND SAFETY PROVISIONS

The Contractor shall provide and maintain sanitary accommodations for use by Contractor and Department employees, in accordance with State and local boards of health, or other legal entity with jurisdiction.

The Contractor shall admit to the Project credentialed Inspectors from OSHA or other agencies responsible for health and safety administration.

107.8.1 STATE AND FEDERAL LAND-MANAGING AGENCIES

While working within or adjacent to State or federal lands and forests, the Contractor shall comply with all regulations of the State or federal authority having jurisdiction governing the protection of these areas, and observe all sanitary laws and regulations. The Contractor shall keep the areas in an orderly condition, dispose of all refuse, and obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other Structures in accordance with applicable federal or State regulations.

107.9 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall provide for the convenience and safety of the general public, for reasonable access by local residents and businesses, and for the protection of persons and property, in accordance with Section 104.5, "Maintenance of Traffic."

107.10 RAILROADS

If the Project affects railroad lines, the Contractor shall observe the requirements of the following Sections and the insurance requirements in accordance with Section 107.25, "Insurance Requirements."

For the purpose of this Section, the term "agreement" means the Contract between the Contractor and railroad that defines the rights and responsibilities of both the Contractor and railroad for the Project. The term "immediate construction site" shall mean the area of the Project defined as having impacts on the railroad in the agreement.

107.10.1 Reserved

107.10.2 Notice to the Railroad

Unless otherwise stated in the Contract, the Contractor shall not begin Work in railroad-owned Right of Way before entering into an agreement with the railroad.

107.10.3 Cooperation with Owner of Railroad Right of Way

The Department is not liable for any additional costs or expenses of the Project resulting from the railroad's reallocation of its labor forces assigned to complete railroad Work in the event of an emergency when the owner of the railroad ROW believes such reallocation is necessary to provide for the immediate restoration of the railroad operations or to protect persons or property on or near any other property owned by the railroad.

107.10.4 Reserved

107.10.5 Reserved

107.10.6 Reserved

107.10.7 Reserved

107.11 ENVIRONMENTAL AND CULTURAL RESOURCES APPROVAL, HAZARDOUS MATERIALS

The Department will obtain the environmental, and Cultural Resource approvals for the Project before construction. The Department will describe in the Contract any environmental and Cultural Resource requirements developed to Protect resources.

The Department will describe in the Contract any Hazardous Materials identified and the Contractor shall observe the requirements of Sections 107.1, "LAWS TO BE OBSERVED," 107.2, "PERMITS, LICENSES, AND TAXES," 107.8, "SANITARY, HEALTH, AND SAFETY PROVISIONS," and the applicable paragraphs of 107.14, "CONTRACTOR'S RESPONSIBILITY FOR ENVIRONMENTAL AND CULTURAL RESOURCE PROTECTION."

107.12 ENVIRONMENTAL, CULTURAL RESOURCE AND HAZARDOUS MATERIALS DISCOVERIES

The Contractor shall terminate operations and provide written notification per Section 104.2.2, "Differing Site Conditions" when it discovers environmental, Cultural Resources or Hazardous Materials not identified in the Contract. The Department will coordinate with appropriate regulatory authorities during this time, the Contractor shall continue Work in other unaffected areas. The Project Manager shall provide written notification to the Contractor when Work may commence in the area of terminated operations.

107.13 CONTRACTOR'S RESPONSIBILITY FOR DAMAGE TO ENVIRONMENTAL AND CULTURAL RESOURCES

The Contractor shall restore or mitigate all damage to environmental or Cultural Resources caused by the Contractor's failure to abide by requirements included in the Contract as well as those areas covered under Section 107.14, "Contractor's Responsibility for Environmental and Cultural Resource Protection" at no additional cost to the Department. The Department, in coordination with regulatory authorities, will determine the extent of restoration or mitigation. The Contractor shall pay any fine imposed on the Department by a regulatory agency for a regulatory violation caused by the Contractor. The Project Manager may suspend the Work in areas where environmental or Cultural Resource violations occur.

107.14 CONTRACTOR'S RESPONSIBILITY FOR ENVIRONMENTAL AND CULTURAL RESOURCE PROTECTION

107.14.1 Environmental and Cultural Resource Studies and Approvals

The Contractor shall obtain new certifications for any Contractor located activity outside the Project limits or for expansions or additions to existing previously certified areas. If the Contractor purchases Material from a Material source established for another Project by another Contractor working under Contract to the Department, and if the Material source must be expanded beyond the area where environmental and Cultural Resource approvals have previously been obtained pursuant to Section 107.14.1, "Environmental and Cultural Resource

Studies and Approvals,” then the requirements for environmental Acceptability shall apply to the additional area and requirements of Section 107.14.1, “Environmental and Cultural Resource Studies and Approvals” must be completed by the Contractor.

Before beginning soil-disturbing activities (in accordance with Section 106.1, “Contractor-Furnished Aggregate and Borrow Sources”), the Contractor shall notify the Project Manager in writing of the proposed studies to be performed. After the Project Manager’s concurrence with the Contractor’s studies the Contractor shall employ an Environmental Specialist and a Cultural Resource Professional to conduct the approved studies. The Contractor shall ensure that the studies meet the standards of the Department, the State historic preservation officer, and any State, tribal, or federal land-managing agency or entity with jurisdiction. The Contractor shall ensure that the resource studies are in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. § 4321 et seq.), the National Historic Preservation Act (16 U.S.C. § 470 et seq.), and the New Mexico Cultural Properties Act (NMSA 1978, § 18-6-1 to 18-6-17), or any other successor statutes. The studies may extend, but are not limited to, the following locations:

1. Camp sites;
2. Plant sites;
3. Crusher sites;
4. Stockpile sites;
5. Equipment yards;
6. Borrow Pits;
7. Surfacing Pits; and,
8. Water sources.

The Contractor shall obtain the environmental and Cultural Resource approvals regardless of land ownership. For the environmental approval, the Contractor shall use the Department-furnished checklist Categorical Exclusion form (or equivalent form furnished by the Department), which shall be signed by the Contractor and the Environmental Specialist.

For Cultural Resource reports, the Contractor shall use the standard site investigation forms approved by the New Mexico Historic Preservation Division and the New Mexico Cultural Properties Review Committee.

The Contractor may use previously-completed environmental and Cultural Resource studies, provided all other requirements of this Section are met.

The Contractor shall submit the documentation prepared for the environmental and Cultural Resource approvals to the Project Manager. Contractor located activities on state land or privately owned land may take 45 Days or more for approval after the Contractor delivers the resource studies to the Project Manager. Contractor located activities on federal land have no defined period for approval. The NMDOT will not approve requests for additional Contract Time or compensation related to Contractor Located Activities.

The Contractor shall comply with all conditions and commitments for protection of resources contained in resource agency requirements and in the environmental and Cultural Resource approvals. The environmental approval is the FHWA-approved checklist categorical exclusion, or its equivalent. The Cultural Resource approval is the concurrence letter signed by the State historic preservation officer, or its equivalent.

The Contractor shall repair at the Contractor’s expense all damage to environmental or Cultural Resources caused by the Contractor’s failure to meet the requirements for

environmental acceptability or abide by Department directives issued to protect resources identified during the environmental and Cultural Resource evaluation. The nature and extent of such repairs shall be determined after consultations between the Contractor, Department representatives, and the regulatory authorities with management jurisdiction over the subject resources.

107.14.1.1 Commercial Material Sources

Environmental Acceptability requirements do not apply to Commercial Material Sources. Upon request of the Project Manager, the Contractor shall submit copies of its Commercial Sources Air Quality Permit, Groundwater Permits, and Business License.

107.14.2 Parking and Cleaning of Equipment

For Projects that have received environmental and Cultural Resource approvals through programmatic categorical exclusions (e.g., pavement preservation and rehabilitation, guardrail replacements, Bridge deck replacements, signalization upgrades, etc.), environmental and Cultural Resource studies will not have been completed outside the existing paved areas by the Department. These Projects will be noted as such in the Contract. For these Projects, the Contractor shall take special care when parking and cleaning Equipment, as outlined in the following requirement.

The intent of the following requirement is to ensure the protection of sensitive environmental and Cultural Resources that may be present within the Right of Way and to encourage the Contractor to avoid damaging these resources when parking and cleaning Equipment. The Contractor shall ensure that parking and cleaning of Equipment within the Right of Way does not damage environmental and Cultural Resources, in one (1) or a combination of the following manners:

1. Park and clean Equipment in previously disturbed areas only;
2. Identify all parking and cleaning locations in previously undisturbed areas, prior to construction, and complete the environmental and Cultural Resource approvals as described in Section 107.14.1, "Environmental and Cultural Resource Studies and Approvals"; or,
3. Park and clean Equipment in previously undisturbed areas without completing the Environmental and Cultural Resource approvals as described in Section 107.14.1, "Environmental and Cultural Resource Studies and Approvals," and assume all risk and liability for any damage to environmental or Cultural Resources resulting from these actions.

107.14.3 Clean Water Act

The Contractor shall comply with the New Mexico Water Quality Act (NMSA 1978, § 74-6-1 et seq.) and applicable permits and regulations in accordance with the federal Clean Water Act (33 USC § 1251 et seq.).

The Department will apply for and obtain permits and certifications required for construction involving "waters of the United States" as defined by the U.S. Army Corps of Engineers. The Contractor shall comply with the terms of the permit obtained and shall be fully liable for consequences resulting from its failure to comply. The Department will provide a copy of the permits and certifications in the Contract.

107.14.4 Minimization of Soil Disturbance

The Contractor shall minimize damage to or removal of vegetation and trees, except as approved in Section 104.6, "Rights in and Use of Materials Found on the Work." The Contractor shall not clear, grub, disturb, or excavate land beyond what is authorized by the Contract. The Contractor shall remediate or replace vegetation due to an unauthorized clearing or damage, at no additional cost to the Department.

107.14.5 Air Quality Requirements and Dust Abatement

The Contractor shall perform dust abatement on the Project and as directed by the Project Manager. The Contractor shall ensure any operations which produce particulate matter comply with State and federal air quality regulations, as administered by the Air Quality Bureau of the NMED, applicable local air quality regulations, and the federal Clean Air Act (42 USC § 7401 et seq.).

107.14.6 Noise Abatement

The Contractor shall not operate Equipment that emits noise above 70 dbA, measured at a distance of 50 ft, in urban or populated rural areas during the hours specified in the Contract, and shall comply with County or municipal ordinances if they are more stringent than the requirements in the Contract.

107.14.7 Disposal of Materials

Unless otherwise specified in the Contract, the Contractor shall be solely responsible for disposal of Materials. In the disposal of Materials the Contractor shall comply with all federal, state and local regulations. The Contractor shall not dispose of Materials within the Project limits without written approval from the Project Manager.

107.14.8 Disposal of Other Materials and Debris

The Contractor shall move items designated for removal without salvage, unsuitable construction Materials, and debris from clearing and grubbing to an environmentally suitable disposal site secured and coordinated with the appropriate regulatory agencies. The Contractor shall not place any items in wetland areas or areas that may impact endangered species or Cultural Resources. The Contractor shall obtain an Environmental and Cultural Resource approval in accordance with Section 107.14.1, "Environmental and Cultural Resource Studies and Approvals."

107.14.9 Prime Coat, Tack Coat, and Soil Sterilants

The Contractor shall not contaminate soils outside the Roadway Prism when applying prime coat, tack coat and soil sterilants. The Contractor shall not contaminate arroyos, irrigation supplies (acequias and ditches), wetlands, water impoundments, and live streams.

107.14.10 Noxious Weed Prevention

To avoid the spread of noxious weeds, all prime and Subcontractor construction Equipment (including but not limited to trucks, excavators, bulldozers, loaders, scrapers, backhoes, trailers, tractors, hydro-seeders, drill-seeders, straw-blasters, compost-spreaders, bobcats, and disks) shall be pressure-washed to remove all visible mud, soil, and debris prior to entering the Project limits.

107.15 HAZARDOUS MATERIALS

The Department will describe in the Contract, all known Hazardous Materials within the Project limits.

107.15.1 Hazardous Material Discoveries

During construction, should Material be encountered which is or the Contractor believes to be hazardous or contaminated, the Contractor shall immediately: terminate operations in the immediate area, notify the Project Manager in writing per Section 104.2.2, "Differing Site Conditions," and the appropriate regulatory authority, and continue Work in other areas. The Project Manager, Environmental Geology Bureau Manager, and environmental regulatory authorities shall investigate to determine the nature and extent of the Hazardous Material or contamination within the Right of Way. If the Contractor is not qualified, as determined by experience and/or licensure, to undertake a clean-up action, the Contractor shall retain the services of a qualified firm. Any adjustments shall be made in accordance with Section 109.5, "Payment for Changes, Differing Site Conditions and Extra Work."

Should the Contractor fail to notify the Project Manager of Hazardous Material discoveries and/or fail to respond in accordance with all applicable environmental regulations or any part of these Specifications; the Contractor shall pay, at no cost to the Department, any fine or penalty imposed for regulatory violations.

107.16 PREVENTION OF FOREST AND GRASS FIRES

The Contractor shall prevent forest and grass fires. The Contractor shall notify appropriate officials at the earliest possible moment of the location and extent of any fire. The Contractor shall comply with fire regulations applicable to the area of Work, and furnish and maintain firefighting Equipment and tools required in the Contract. The Contractor shall suspend fire-hazardous operations when necessary at the direction of the Project Manager.

If performing Work within or adjacent to State or National Forests, the Contractor shall comply with all regulations of the USDA Forest Service, State Forestry Division, New Mexico Department of Energy, Minerals and Natural Resources, or other authority having jurisdiction, governing the protection of forests and the performance of Work within forests. The Contractor shall keep the areas in an orderly condition, dispose of all refuse, and obtain permits for the construction of field offices and other structures in accordance with the requirements of the Forest Supervisor.

The Contractor shall take all reasonable precautions to prevent and suppress forest fires and shall require employees and Subcontractors to take all reasonable measures within their power to prevent and suppress forest fires. The Contractor shall make every possible effort to notify a Forest official at the earliest possible moment of the location and extent of a fire.

107.17 USE OF EXPLOSIVES

The Contractor shall exercise extreme care when use of explosives is necessary for the prosecution of the Work. The Contractor shall be responsible for all damage resulting from the use of explosives. The Contractor shall not endanger life or property, including new Work. The Contractor shall use, handle, load, transport, and store explosives and blasting agents in accordance with applicable laws and ordinances, as well as title 29 CFR Part 1926 Safety and Health Regulations for Construction (OSHA) and 30 CFR Part 15.32 whichever is more restrictive. The Contractor shall clearly mark explosives and store them securely. If no local laws or ordinances apply, the Contractor shall store explosives not closer than 600 feet from Roads, buildings, camping areas, or places of human occupancy. Unless otherwise required by an agreement between the Contractor and public utility or owner of railroad ROW, the Contractor shall provide five (5) Days' notice to any public utility and owner of railroad ROW

having Structures or facilities near the Project, of the intention to use explosives, so that they may take steps to protect their property before detonation.

107.18 PROTECTION AND RESTORATION OF PUBLIC AND PRIVATE PROPERTY

The Contractor shall preserve public and private property including land, governmental survey monuments, and property markers from disturbance or damage until the Project Manager has witnessed or otherwise referenced their location, and directed their removal.

The Contractor shall restore public or private property damaged and pay fines directly or indirectly caused by the Contractor through any act, omission, neglect, or misconduct in the execution of the Work, or by defective Work or Materials, or by non-prosecution of the Work. The Contractor shall return such property to a condition equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as directed by the Project Manager. The Contractor shall maintain responsibility for damage until the Work is completed and Accepted. The Contractor shall provide the Department with the information to update the control sheet records once a reference mark has been reestablished by the Contractor.

107.18.1 PUBLIC AND PRIVATE REFERENCE MARKS

Unless otherwise specified in the Plans, the Contractor shall not disturb or damage any public or private reference marks. If the Contractor directly or indirectly by any act, omission, neglect, or misconduct in the execution of the Work disturbs or damages public or private reference marks the Contractor shall be solely responsible for any restoration of the reference marks in accordance with Section 801, "Construction Staking by the Contractor." If the restoration of the public or private reference mark is done improperly then the Contractor shall be solely responsible for a fine of \$2,000.00 per improper reference mark. Delays, costs or impacts associated with the improper restoration of a reference mark shall be the sole responsibility of the Contractor.

107.19 RESPONSIBILITY FOR THIRD PARTY CLAIMS AND DUTY TO DEFEND

The Contractor shall indemnify and hold harmless the Department and its officers, employees and agents from and against any and all Claims and suits, liability, damages, losses or expenses, including attorney fees and costs, to the extent that they arise out of or are in any way connected with any act or omission of the Contractor, or its officers, employees or agents. The Contractor agrees, at its own expense, and upon written request by the Department, to defend any suit, action or demand brought against the Department on any Claim or demand covered herein.

The Contractor shall establish a local contact number (with area code) for filing Claims, and clearly post the number. In addition, post the name of the Contractor and telephone number at each approach and departure to the Project. The Contractor shall ensure that construction vehicles (Contractor, Subcontractor, and privately owned) working on the Project have clean, unobstructed license plates, and shall mark vehicles legibly with the appropriate company name.

The Contractor shall assign an individual by the date of the Pre-Construction Conference, readily available during normal Working hours, to respond to Claims from the public for losses alleged to have occurred within the Project, whether arising from Contractor or Subcontractor action or inaction. The Contractor shall provide claimants with a written outline of the Contractor's Claims procedure, along with a written copy of the Contractor's name, address, and telephone number together with the name and title of the individual assigned to handle Claims from the public and provide a copy of the same to the Project Manager. The

Contractor shall maintain a status report of Claims filed, including the name, address, and telephone number of the claimant, the nature of the Claim, pertinent findings regarding the Claim, and a statement regarding the resolution of the Claim. The Contractor shall provide the status report to the Project Manager upon request.

107.20 CONTRACTOR'S RESPONSIBILITY TO PROTECT THE WORK

Until Final Acceptance of the Project by the Project Manager, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof, by the action of the elements or from other causes, whether arising from the execution or from the non-execution of the Work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to portions of the Work occasioned by the above causes before Final Acceptance and shall bear the expense thereof except as provided in Section 104.5, "Maintenance of Traffic" and Section 105.18.1, "Partial Acceptance."

Should the Contractor be Delayed in the prosecution or completion of the Work by Contractors on contiguous Projects, Acts of God such as fire, flood, earthquake, tornado, or other cataclysmic phenomena of nature, epidemic, quarantine restriction, strike, freight embargo, acts of public enemy, acts of governmental authorities or railroads other than the Department, or documented national unavailability of construction Material, for which the Contractor is in no way responsible, then the Contractor may be entitled to an extension of Contract Time per Section 108.6, "Determination and Extension of Contract Time," but is not entitled to additional compensation or damages for such Delay. For physical damage to the Work resulting from the above unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, the Contractor may be paid pursuant to Section 109, "Measurement and Payment." The Contractor shall not be entitled to non-allowable damages per Section 109.11, "Compensation for Claims."

In case of suspension of Work per section 105.8.1, "Project Manager Authority," the Contractor shall be responsible, subject to the provisions of Section 104.5, "Maintenance of Traffic," for the Project and shall take such precautions as may be necessary to prevent damage to the Project.

107.21 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES

The Contractor shall not begin Work in areas close to railroad, telecommunication, or utility company Right of Way or facilities, or other property where damage from the Work might result in expense, loss, or inconvenience to the owner, until arrangements are made with the Project Manager and the owner of the property for the protection of such property or facilities.

The Contractor shall promptly notify the Project Manager and affected utility or railroad owners of any interruption to services resulting from exposure, lack of support, or breakage. The Contractor shall provide continuous repair Work to restore water service if interrupted. The Contractor shall not perform Work near fire hydrants until provision for service has been approved by the local fire authority.

107.22 FURNISHING RIGHT OF WAY

The Department will secure necessary Right of Way before construction, except as noted in the Contract.

107.23 PERSONAL LIABILITY OF PUBLIC OFFICIALS

Department employees shall bear no personal liability in carrying out the provisions of the Contract or in exercising powers or authority granted to them by the Contract, it being

understood that in such matters they act solely as agents and representatives of the Department.

107.24 NO THIRD-PARTY LIABILITY

The Department and the Contractor specifically agree that the provisions of this Contract do not make anyone, including any Subcontractor or Materials Supplier, a third-party beneficiary or authorize anyone not a party to this Contract to maintain an action for damages under this Contract.

107.25 INSURANCE REQUIREMENTS

The Contractor shall procure and maintain at no cost to the Department insurance as detailed below, using an insurance company authorized to do business in New Mexico. Insurance shall cover operations under the Contract, whether performed by the Contractor, the Contractor's agents or employees, or Subcontractors. The Contractor shall keep insurance in full force and effect for the entire period of the Work, up to and including Final Acceptance, and the removal of Equipment and employees, agents and Subcontractors. All insurance required in this Section shall be procured from insurance or indemnity companies with an A.M. Best Company financial strength rating level of A- or better, Class VII or better, unless otherwise approved in writing by the Department. In no event shall the Department approve the use of an insurance or indemnity company with an A.M. Best Company financial strength rating level of B or worse.

107.25.1 Liability Insurance

1. The Contractor shall obtain General Liability (Bodily Injury Liability and Property Damage Liability) insurance coverage applicable in full to the subject Project in the following minimum amounts:
 - a. Personal and Bodily Injury Liability: \$1,000,000.00 each person; \$2,000,000.00 each occurrence (annual aggregate); and,
 - b. Property Damage Liability: \$2,000,000.00 each occurrence; (annual aggregate);
2. The insurance coverage shall be documented on a Comprehensive General Liability form or Commercial General Liability form, which must include the following:
 - a. Coverage for liability arising out of the operation of independent Contractors;
 - b. Completed Operations Coverage; and,
 - c. Attachment of the Broad Form Comprehensive General Liability Endorsement;
3. If the Work includes the use of explosives, the Contractor's insurance must include coverage for injury to or destruction of property arising out of blasting or explosion;
4. If the Contract includes Work next to an existing building or structure, the Contractor's insurance shall include coverage for injury to or destruction of property arising from the collapse of or structural injury to buildings or Structures due to the following:
 - a. Excavation, including borrowing, filling, or backfilling in connection therewith;
 - b. Tunneling and cofferdam or caisson Work; and,
 - c. Moving, shoring, underpinning, razing, or demolition of buildings or Structures, or removal or rebuilding of structural supports thereof; and,
5. Coverage must include injury to or destruction of property arising out of damage to wires, conduits, pipes, mains, sewers or other similar property or any apparatus in connection therewith below the surface of the ground, if such injury or destruction is

caused by or occurs during the use of mechanical Equipment for the purpose of excavating, digging, or drilling.

107.25.2 Automobile Liability Insurance

The Contractor shall provide or ensure that all vehicles used in performance of the Contract have liability insurance. The Contractor is not responsible for liability insurance for the Department or its agents. The Contractor shall provide limits of liability for automobile liability insurance in the following amounts:

1. Personal and Bodily Injury Liability: \$1,000,000.00 each person; \$2,000,000.00 each occurrence; (annual aggregate); and,
2. Property Damage Liability: \$2,000,000.00 each occurrence; (annual aggregate).

107.25.3 Worker's Compensation Insurance

The Contractor shall carry worker's compensation insurance and otherwise fully comply with the New Mexico Worker's Compensation Act (NMSA 1978, § 52-1-1 et seq.) and the New Mexico Occupational Disease Disablement Law (NMSA 1978, § 52-3-1 et seq.).

107.25.4 Department as Additional Insured

The Contractor shall name the Department and any third party so designated in the Contract as an additional named insured on the comprehensive general liability form or commercial general liability form furnished by the Contractor in accordance with Section 107.25.1, "Liability Insurance." The certificate of insurance shall state that the coverage provided under the policy is primary over any other valid and collectible insurance. The additional insured endorsement shall conform to the most current version of the Insurance Services Office's CG 2010 or equivalent, Additional Insured Endorsement Form. The Contractor shall provide to the Department a copy of the Contractor's standard commercial general liability policy showing the Additional Insured Endorsement before the Department issues a Notice to Proceed.

107.25.5 Certificate of Insurance

The Contractor shall provide evidence of insurance coverage conforming to these Specifications with a certificate of insurance executed on the form provided by the Department, to be made part of the Contract. The certificate shall indicate compliance with these Specifications and shall certify that the coverage shall not be changed, canceled, or allowed to lapse without giving the Department 30 Days written notice. The Contractor shall provide a certificate of insurance to the Department on renewal of a policy or policies as necessary during the term of the Contract. The Department shall not issue a Notice to Proceed until the Contractor meets these requirements.

107.25.6 Umbrella Coverage

The insurance limits cited in this Section are minimum limits. The Department does not intend that these Specifications define what constitutes adequate insurance coverage for the individual Contractor. The Department will recognize excess coverage (Umbrella) as meeting the insurance requirements of Section 107.25.1, "Liability Insurance," if the limits of the Umbrella coverage meet the individual requirements of this Section.

107.25.7 Optimal Insurance

If required by the Contract, Contractor shall procure and maintain form and types of bailee theft insurance such as, but not limited to, builder's risk insurance, Contractor's Equipment insurance, and rigger's liability property insurance. If so required, the Contractor shall provide bailee theft insurance in an amount necessary to protect the Department against Claims, losses, and expenses arising from the damage, disappearance, or destruction of property of others in the care, custody, or control of the Contractor, including property of others being worked upon by the Contractor, its agents, employees or Subcontractors.

107.25.8 Railroad Insurance

If the Work affects railroad property, in addition to the above requirements, unless otherwise specified in the Contract the Contractor shall obtain at its own cost a railroad protective liability policy in the name of the owner of the railroad Right of Way or railroad facilities involved. In addition, on those rails used by the National Railroad Passenger Corporation (NRPC), the Contractor shall obtain a railroad protective liability policy in the name of the NRPC.

Railroad liability insurance shall be in compliance with 23 CFR 646A. These limits of liability apply to the coverage as set forth in AASHTO's Railroad Protective Liability Endorsement form, subject to the terms, conditions, and exclusions found in the form. The policy must afford coverage as provided in the standard Railroad Protective Liability Endorsement.

107.26 NO WAIVER OF LEGAL RIGHTS

Upon completion of the Work the Department will pay the final payment voucher. Payment of the final payment voucher shall not preclude the Department from correcting any measurement, estimate, or certificate made before or after completion of the Contract, nor from recovering from the Contractor or surety or both, overpayments sustained because the Contractor failed to fulfill the obligations under the Contract. A waiver on the part of the Department of any breach of any part of the Contract shall not be held to be a waiver of any other subsequent breach.

The lack of discovery or rejection of a defect shall not preclude, nor obligate the Department to Accept the defect.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, and for warranty and guaranty.

107.27 CONTRACTOR'S RESPONSIBILITY TO THE TRAVELING PUBLIC

The Contractor shall minimize hazards to the traveling public in the Construction Zone from the commencement of the Work until Final Acceptance. Minimizing hazards shall include:

1. Keep Equipment, Materials, and workers out of the travel lanes;
2. Remove hazardous construction debris deposited within the Project limits;
3. Inspect and repair the travel lanes (Necessary repairs of damage not caused by the Contractor will be paid for in accordance with Section 109.5, "Payment For Changes, Differing Site Conditions, and Extra Work."); and,
4. Remove obstacles deposited by the public as they transit the Project.

The Contractor shall immediately correct hazards reported by Project inspections, Department employees, or the public. The Contractor shall maintain and publicly post a 24-hour contact number to initiate action quickly.

107.28 CONTRACTOR RECORDS

The Contractor, Subcontractors and all Suppliers shall keep and maintain all documents in a useable format, including communications, books, papers, records, files, accounts, tax records, cost records, reports, schedules, Bid documents with backup data, including electronic data, and all other Material relating to the Contract, Project, Contract compliance, or any Claim for five (5) years following Physical Completion of the Work. Unless otherwise specified in the Contract all of the above Material shall be made available to the Department for review, audit, inspection and copying and shall be produced, upon request by the Assistant District Engineer – Construction, at the Department General Office, the District in which the Work was performed, or an FHWA office, as directed. The Contractor shall insert the above requirement in each subcontract and shall also include in all subcontracts a clause requiring Subcontractors to include the above requirement in any lower-tier subcontract. The Contractor's failure to maintain and timely provide all requested documents to the Department waives any Claim the basis of which could have, either in whole or in part, been documented or rebutted by such documents.

Resource Loading documents, financial statements provided by the Contractor, and Escrowed Bid Documents which have been visibly marked by the Contractor as "Confidential Trade Secrets" shall be deemed confidential as trade secrets and not subject to inspection pursuant to the Inspection of Public Records Act, NMSA 1978, § 14-2-4. Such information shall not be disclosed by the Department in response to a request made pursuant to the Inspection of Public Records Act without the written permission of the Contractor. Such documents may be disclosed to the Department, including any Inspector, Project Superintendent, Project Manager, Claim consultant, investigator, or testifying or consulting expert, as necessary to perform their duties or as otherwise required by law.

107.29 ASSIGNING OF CONTRACT

The Contractor may not assign the Contract or assign or delegate any contractual obligation or duty without the prior written consent of the Department and the Surety. Contractor may not make any assignment, in connection with the Contract, including assignment of any payment due Contractor or any Claim, for the benefit of any creditor.

107.30 SEVERABILITY AND CONTRACT INTERPRETATION

If any provision of this Contract is held to be invalid or unenforceable, the remaining provisions, or the application of such provision to either party, shall remain in full force and effect and, if possible, the rights and obligations of the parties are to be construed and enforced as if the Contract did not contain that term.

If any provision of the Contract is found to be superseded by any applicable state or federal law or regulation or court order, in whole or in part, then both parties shall be relieved of all obligations under that provision only to the extent necessary to comply with the superseding law or ruling, provided however, that the remaining provisions of the Contract, or portions thereof, shall be enforced to the fullest extent permitted by law.

The Contractor agrees that any rule of construction to the effect that ambiguities are to be resolved against the drafting party shall not be applied in the construction or interpretation of this Contract.

107.31 CHOICE OF LAW

This Contract is governed by and construed in accordance with the laws of the State of New Mexico.

SECTION 108: PROSECUTION AND PROGRESS

108.1 SUBCONTRACTING

Any individual, partnership, firm, corporation, or joint venture performing Work on the Project that is not an employee of the Contractor is a Subcontractor unless otherwise stated in the Contract.

A Supplier or Fabricator is not a Subcontractor unless Work is being performed within the Project limits.

The Contractor shall perform with its own organization at least 40.0% of the Work based on the Total Bid Amount. The phrase, "its own organization" includes only workers employed and paid directly, inclusive of employees who are employed by a lease agreement Acceptable to the Department and Equipment owned or rented or without operators and does not include employees or Equipment of the Subcontractor, assignee or agent of the Subcontractor. The Contractor is solely responsible and liable for the performance of all Work or any act by its Subcontractors, Truckers, and Suppliers on the Project. Liability of the Contractor and the Contractor's Surety under the Contract and the Contract Bonds shall not be waived or diminished by subcontracting or any other assignment of interest.

The Contractor shall submit to the Project Manager a request to Subcontract on the current Department approved form. The form must be concurred to by the Department before the subcontracted Work begins. Unless otherwise approved by the Project Manager, the request to Subcontract shall be submitted no later than two (2) Working Days before the Subcontract Work is scheduled to begin. The Contractor shall not circumvent this requirement by placing a Subcontractor's employees on its payroll. If the Contractor does not perform at least 40.0% of the Work with its own organization requests for Subcontractor approval will be rejected. The Department will treat a person or group generally operating as an independent Contractor, as independent Contractors for the purposes of this Section. An independent Contractor is a person who is paid for Work by the Contractor who is not the Contractor's employee and is not performing Work within the Project limits such as the Contractor's attorney or accountant.

The Contractor is responsible for ensuring that its Subcontractors are prequalified by the Department and are also duly licensed for the Work to be performed on the Project, are registered with all of the state agencies as is required to do business in New Mexico and to perform Work on Public Works Projects including the New Mexico Taxation and Revenue Department and the New Mexico Department of Workforce Solutions or successor agencies, and are in compliance with all applicable state and federal laws and regulations including the New Mexico Public Works Minimum Wage Act. The Contractor shall comply with the New Mexico Subcontractor Fair Practices Act to the extent it is applicable to the Project. The Contractor shall update its list of Subcontractors and Suppliers submitted at the Pre-Construction Conference as the Work progresses.

A Trucker is not a Subcontractor unless the Contractor is using the Trucker to meet the DBE goal associated with the Project. A Trucker is an individual, partnership, firm, corporation, or joint venture that transports Materials to and from the Project and does not perform Work within the Project Limits. Transportation of Materials within the Project Limits is Work performed by the Contractor or a Subcontractor. Transportation of Materials on or off the Project site does not require a Subcontract.

The Contractor shall not construe the Department's concurrence as an endorsement of the subcontract, the Subcontractor, or the Subcontractor's ability to complete the Work in a satisfactory manner. Subcontracting creates no Contract between the Department and the

Subcontractor. The Subcontractor gains no rights, and the Department Accepts no responsibilities by reason of the Subcontractor's Contract with the Contractor.

108.1.1 Prompt Payment

The Contractor shall promptly pay its Subcontractors and Suppliers for satisfactory performance of their Contracts no later than thirty (30) Days after receipt of Progress Payment for the Subcontractor's Work or Supplier's Materials by the Department.

For purpose of this section, a Subcontractor's and Supplier's portion of the Work is satisfactorily completed when the Department processes a Progress Payment per Section 109.8, "Progress Payment." In no event shall the Contractor and its Subcontractors fail to promptly pay their Subcontractors and Suppliers the amounts due for undisputed Accepted Work within thirty (30) Days of the Contractor receiving a Progress Payment from the Department. The payment by the Department to the Contractor is not a condition precedent for payment by the Contractor to any Subcontractor or Supplier. A zero dollar (\$0.00) Progress Payment by the Department does not relieve the Contractor from paying the Subcontractor or Supplier for Accepted Work.

The Contractor's failure to make timely or prompt Subcontractor or Supplier payment may result in the Department rejecting the Contractor's future Bids in accordance with Section 102.5, "Rejection of Bids." The Contractor's repeated failure to make timely Subcontractor payment may also lead to Suspension or Debarment in accordance with Section 102.3, "Suspension and Debarment."

108.2 NOTICE TO PROCEED AND PRE-CONSTRUCTION CONFERENCE

108.2.1 Notice to Proceed

The Department may issue the Notice to Proceed within 30 Days after the Department's Contract execution, unless otherwise agreed to by the parties. The Notice to Proceed will identify the timeframe the Contractor shall begin Work and when Contract Time shall begin. The Contractor's shall not commence Work without a Notice to Proceed.

108.2.2 Pre-Construction Conference

After the issuance of the Notice to Proceed, the Project Manager will provide written notice to the Contractor of the date, time and location of the Pre-Construction Conference. The Pre-Construction Conference will occur during the timeframe in the Notice to Proceed. If the Contract has ramp up time, the Pre-Construction Conference shall occur before the ramp up time commences.

The Contractor shall ensure the Project Superintendent or the individual who executed the Contract attends the Pre-Construction Conference. The Contractor's shall not commence Work without a Pre-Construction Conference and the items above are Accepted by the Department. Commencing Work without a Pre-Construction Conference may result in a Non-Conformance. Contract Time shall commence as indicated in the Notice to Proceed and no additional Contract Time will be granted.

The Contractor shall provide the following at a minimum of ten (10) Days before Pre-Construction Conference. The Pre-Construction will not be held until the required items are provided to the Department:

1. Letters of assignment (official capacity) for Project;
 - a. Project Superintendent;
 - b. Company and Project Safety Officer;

- c. Traffic Control Supervisor (include current certifications and copy of wallet card)
- 2. A list with samples of authorized signatures and assignments for Supplemental Agreements (Change Orders), Progress Payments, payrolls and related items;
- 3. Baseline Schedule;
- 4. Additions, revisions deletions to the Traffic Control Plan;
 - a. Proposed changes to the Project;
 - b. Potential problems with the construction of the Project;
- 5. List of Subcontractors and Material suppliers;
- 6. Lump Sum breakdowns;
- 7. Weighmasters / Deputy Weighmaster certifications (must be maintained throughout the duration of the Project);
- 8. Progress Payment cutoff date;
- 9. Company EEO policy statement;
- 10. Recruitments letters (attachments E-K of the EEO package);
- 11. Superintendent's indoctrination letter (attachment D of EEO package);
- 12. If applicable the on-the-job training letter (Attachment R of the EEO package);
 - a. The trainee classification letter must include the number of trainees to be trained, the training program to be used, the classification of each trainee and the approximate start date;
- 13. The completed Civil Rights / EEO Pre-Construction Report. Complete and sign the portions that are applicable Department Project personnel;
- 14. Pre-Construction safety questionnaire;
- 15. VECP form; and,
- 16. Other items and any other documents required by the Contract or as directed in the Project Manager's notice of Pre Construction.

108.3 SCHEDULE

108.3.1 Baseline Schedule

The Project shall utilize a CPM format as the Baseline Schedule unless otherwise specified in the Contract.

The Project Manager will notify the Contractor in writing within ten (10) Days of the submittal of a Baseline Schedule if the schedule is "Accepted," "Accepted as noted," or is "rejected." For Baseline Schedules that are "rejected," the Project Manager shall communicate, in writing, to the Contractor all portions of the schedule that are not in compliance with the Contract requirements. The Contractor shall, within seven (7) Days of receipt of the reasons for rejection of the schedule, provide a new Baseline Schedule and all additional information necessary for the Project Manager to "Accept" the Baseline Schedule. The Project Manager will notify the Contractor in writing within seven (7) Days of the submittal of the corrected Baseline Schedule if the schedule is "Accepted," "Accepted as noted", or is "rejected." The Contractor's failure to provide a timely and Acceptable new Baseline Schedule in response to a rejected schedule waives any Claim the basis of which would have been documented by an Acceptable Baseline Schedule.

Unless otherwise specified in the Contract, the Contractor is wholly and solely responsible for construction means, methods or techniques, therefore the Project Manager's

review of the Baseline Schedule will be for compliance with the Specifications and Contract requirements. Acceptance by the Project Manager shall not relieve the Contractor of any of its responsibilities for the accuracy or feasibility of the schedule. Any Baseline Schedule which exceeds the as let Contract Time may be "Accepted as noted" and does not revise the Contract Documents, including Contract Time, unless accompanied by a related Change Order. The Department's Acceptance of a Baseline Schedule that exceeds as let Contract Time shall not operate as a waiver of the Department's right to assess liquidated damages. A Baseline Schedule that reflects a completion date before the expiration of Contract Time does not revise the as let Contract Time and will be considered float for the exclusive use and benefit of the Department. The Contractor shall not commence Work until the Project Manager Accepts a Baseline Schedule.

The Department will use the Baseline Schedule to measure Project performance and for evaluation of changes to the Contract. Failure by the Contractor to include any element of Work required for performance of the Contract shall not excuse the Contractor from completing all Work within the required time.

108.3.1.1 CPM Baseline Schedule

Unless otherwise specified in the Contract the Contractor shall provide a CPM Baseline Schedule which clearly describes the following:

1. Created in the most current version of the scheduling software identified in the Contract;
2. Identifies the Project's Critical Path;
3. Includes all activities required to complete the Work, including but not limited to, engineering, surveying, permitting, submittals, approvals, procurement, fabrication, deliveries, crushing, utility Work and third party Work;
4. Includes milestones, interim Completion Dates, Substantial Completion Date, physical Completion Date, and other key dates specified in the Contract;
5. Describe activities such that the Work is readily and identifiable. The activities shall provide the station or location of the Work;
6. Identifies the scheduled early and late start and finish dates for each activity;
7. Limits activity relationships to finish to start, start to finish, and finish to finish relationships. Use of leads and lags must be explained in the narrative;
8. Use only contractual date constraints, unless otherwise approved by the Project Manager;
9. Defines the Work calendar for each activity;
10. Narrative at a minimum including the Plan for sequencing the Project;
11. Defines the duration of each activity;
12. Total float and free float for each activity;
13. Workdays each week;
14. Contractor designated Holidays;
15. Number of shifts and Work hours per Day;
16. Anticipated weather events, based on historical data from the last seven (7) years;
17. Resource loading that shows production rates; and,
18. Cost loading that shall include the projected Project completion, measured in dollars and time, on a monthly basis or at each Progress Payment cut-off date.

108.3.2 Schedule Format

108.3.2.1 CPM Schedule Format

The Project shall utilize a CPM format as the Baseline Schedule unless otherwise specified in the Contract.

The Contractor shall prepare and submit one (1) electronic copy and two (2) time-scaled color prints of the CPM Baseline Schedule, updated monthly schedule, and revised schedules using a Project scheduling software as directed by the Department that includes the following features:

1. Ability to display the schedule as a Gantt chart;
2. Ability to clearly display the Critical Path of scheduled activities apart from the non-critical scheduled activities;
3. Ability to calculate and display total float and free float for each activity;
4. Ability to clearly display the early start, late start, early finish and late finish dates for each activity; and,
5. Ability to easily store and transfer the schedule as a file (or files) from one computer to another.

108.3.2.2 Bar Graph Baseline Schedule

If required by the Contract the Contractor shall submit the Baseline Schedule in bar graph form. The Baseline Schedule shall list Contract features or Work activities in sufficient detail to show a reasonable and workable plan to complete the Project within the Contract Time. The Contractor shall show the following on the bar graph Baseline Schedule:

1. Each Work activity as a bar;
2. Each activity's planned start and Completion Dates;
3. Each activity's estimated cost and percent of Total Bid Amount;
4. The overall Project cost;
5. The planned Project Completion Date;
6. The monthly projected percent complete in time and dollars;
7. A plot of the monthly projected percent complete (in dollars) superimposed on the bar chart; and,
8. Any approved Project suspensions and time extensions.

108.3.3 Monthly and Revised Schedules

For this Section "schedule" refers to CPM or Bar Graph as required by the Contract. The Department considers an updated monthly schedule as an update to the Accepted Baseline Schedule when no changes in activities have occurred except for the progression of planned Work. The Department considers a revised schedule as a schedule that modifies the Accepted Baseline Schedule. If Accepted the revised schedule becomes the current Baseline Schedule.

Each activity in a monthly or revised schedule shall contain the same information required for the Baseline Schedule. Any updated or revised schedule that exceeds the as let Contract Time may be Accepted as Noted and does not revise the Contract Documents, including Contract Time, unless accompanied by a related Change Order. The Department's Acceptance of an updated or revised schedule does not operate as a waiver of the Department's right to assess liquidated damages.

The Contractor shall submit an updated or revised schedule in accordance with 108.3.3.1, "Monthly Schedule Update." If the Contractor fails to submit an Acceptable schedule, the Department may take action in accordance with Section 109.8.2, "Non-Conformance." The Contractor's repeated failure to provide Acceptable monthly or revised schedules may lead to Suspension or Debarment in accordance with Section 102.3, "Suspension and Debarment." Failure to timely provide a monthly or revised schedule waives any Claim the basis of which would have been documented by an Acceptable monthly or revised schedule.

Float generated on Critical Path activities due to the acceleration of the Contractor's performance, at the written direction of the Project Manager, shall be for the exclusive use of the Department; and, float generated on Critical Path activities due to modification, reduction or elimination of items shall be for the exclusive use of the Department. The float generated by a VECP may be split equally for the mutual use of the Department and the Contractor.

The Department may grant time extensions only to the extent that the activities on the Critical Path of the CPM Baseline Schedule in effect at the time of the Delay are impacted.

108.3.3.1 Monthly Schedule Update

The Contractor shall submit an updated schedule monthly by the Progress Payment cut-off date.

108.3.3.2 Contractor's Independent Duty to Provide Schedule Revisions

If it becomes apparent, or should have become apparent to the Contractor that the Contractor cannot complete the Work within the Contract Time, the Contractor shall provide a revised schedule and recovery Plan to the Project Manager within five (5) Days. When the Critical Path changes, and when applicable, the Contractor shall provide a revised schedule and recovery Plan to the Project Manager within five (5) Days.

If the Work falls behind schedule, the Contractor shall take such steps as may be necessary to mitigate damages and improve its progress including development of a recovery Plan. For an Excusable Delay, Non-compensable Delay, Concurrent Delay, as those terms are identified in Section 109.11, "Compensation for Claims," the Contractor shall take all reasonable steps to minimize the impact of the Delay once a Delay causing event is identified. Failure to do so may result in the rejection of all or part of the Delay Claim.

If the Delay cannot be mitigated, the Contractor shall promptly submit either a written request for an extension of the Contract Time pursuant to Section 105.19, "Notice of Intent Claim," and Section 105.20, "Administrative Remedy," or request approval of a late completion schedule and shall be liable for liquidated damages.

For an Inexcusable Delay or a Non-excusable Delay, as those terms are identified in Section 109.11, "Compensation for Claims," the Contractor shall consider as a minimum the following potential schedule mitigation techniques: increase the number of shifts, begin overtime operations, Work extra Days including weekends and Holidays, or supplement its construction plant and submit, as provided in this Section, a revised schedule with a proposed recovery Plan, as may be deemed necessary to demonstrate the manner in which the agreed rate of progress shall be regained, all at no cost to the Department.

The revised schedule shall show Contract Time, Project completion date and all additional information necessary for the Project Manager to "Accept" the revised schedule. The Contractor's failure to provide a timely and Acceptable revised schedule waives any Claim

the basis of which would have been documented by an Acceptable revised schedule. The Project Manager will provide the Contractor with a decision in writing within five (5) Days of receiving the revised schedule. The revised schedule shall become the current Accepted Baseline Schedule.

108.3.3.3 Schedule Revisions at Request of Department

If it becomes apparent to the Department that the Contractor cannot meet the schedule, the Project Manager may request a schedule revision and recovery plan from the Contractor. The Contractor shall, within five (5) Days of receipt of the request, provide a revised schedule. The Project Manager will provide the Contractor with a decision in writing within five (5) Days of receiving the revised schedule. The revised schedule shall become the current Accepted Baseline Schedule. The Contractor's failure to provide a timely and Acceptable response waives any Claim the basis of which would have been documented by an Acceptable revised schedule.

108.3.3.4 Schedule Update and Revision Information

The Contractor's updated monthly and revised schedules shall conform to the requirements of Section 108.3.1, "Baseline Schedule" and shall show:

1. Actual start and finish dates of each activity;
2. Remaining duration of activities started but not yet completed;
3. Delays and changes resulting from the addition, deletion or revisions to activities due to the issuance of a Change Order, change to an activity duration, changes to relationship between activities or changes to the planned sequence of Work or the method and manner of its performance; and,
4. Narrative report describing;
 - a. Processes during the month;
 - b. Shifts in the critical activities from the previous update;
 - c. Sources of Delay;
 - d. Weather Days;
 - e. Traffic switches;
 - f. Allocations of crews;
 - g. Work completed the previous month;
 - h. Potential problem areas;
 - i. Work planned for the next update period; and,
 - j. Changes made to the schedule.
 - k. The Superintendent shall sign the narrative and provide certification statement stating that the progress shown on the schedule update accurately represents Work completed through the date indicated.

108.4 UNSATISFACTORY PROGRESS OF WORK

The Project Manager will issue a notice of unsatisfactory performance to the Contractor. The notice shall be sent by certified mail and identify the unsatisfactory performance.

The progress of the Work is deemed unsatisfactory when:

1. The dollars earned by the Contractor on the Project are 15% less than the estimated dollars earned, as shown on the current Accepted baseline progress schedule;

2. When the start of an activity on the Critical Path, as shown on the current Accepted progress schedule, has exceeded its late start date by seven (7) Days;
3. When an activity on the Critical Path, as shown on the current Accepted progress schedule, has exceeded its original duration by ten (10) or more Days; or,
4. When the Project Manager determines that the progress of Work is unsatisfactory.

When the progress of the Work is deemed unsatisfactory the Project Manager and the Contractor shall meet to address the schedule within five (5) Days. The Contractor shall provide a revised schedule with a narrative addressing Project progress compliance or anticipated liquidated damages. The Department's approval of a late completion schedule will not operate as a waiver of the Department's right to assess liquidated damages. Failure by the Contractor to address the unsatisfactory progress within five (5) Days after the meeting, will result in the Project Manager issuing a Notice of Apparent Default to the Contractor per Section 108.9, "Default of Contract."

108.5 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT

108.5.1 Character of Workers

The Contractor shall provide the resources necessary to complete the Work as specified. The Contractor shall ensure workers have the experience and skills to perform assigned Work.

The Contractor shall remove employee(s) who perform the Work in an unskilled manner, is ineligible to perform the Work, or who is intemperate or disorderly. The Contractor shall allow these employees to return to the Project only with the Project Manager's written permission.

If the Contractor or its employee(s) fail to comply with these requirements the Project Manager may suspend the Work at no cost to The Department.

108.5.2 Methods and Equipment

The Contractor shall use methods and Equipment capable of performing the Work specified in the Contract. The Contractor shall ensure that the Equipment does not damage the Roadway, adjacent property or other Highways, Streets, or Roads.

The Contractor shall request permission of the Project Manager in writing to use methods or Equipment other than those specified in the Contract. The Contractor shall describe the proposed methods and Equipment to be used and the reasons for the change. The Contractor shall perform Work in accordance with the original Basis of Payment and Contract Time. The Contractor shall discontinue use of alternate methods or Equipment when Work does not meet Contract requirements. The Contractor shall remove and replace unacceptable Work or repair deficient Work at no cost to The Department.

108.6 DETERMINATION AND EXTENSION OF CONTRACT TIME

The Department will provide the Contract Time in the Advertisement, in Working Days, Days, or Mandatory Completion date.

For Working Day Projects, the Project Manager will provide the Contractor with a weekly statement showing the Contract Time, the number of Working Days used, the accumulated Working Days charged, and the number of Working Days remaining to complete the Work. The Contractor shall have three (3) Days after receipt of the weekly statement to object in writing to the weekly statement, setting forth the specific dates and justifications for the

objection. If the Project Manager finds that the Contractor's objection is valid, or if there is an error, then the Project Manager will issue corrected weekly statement(s). If the Project Manager determines that the objection is not valid the Project Manager will notify the Contractor in writing. If the Contractor continues to object to the weekly statement then the Contractor may file a Notice of Intent to Claim. If the Contractor fails to timely object, the weekly statement is deemed Accepted by the Contractor.

The Contractor is not entitled to a Partial Suspension, at its own request, when any of the conditions below apply:

1. Projects with a Bar Graph Schedule;
2. Projects with a Mandatory Completion Date;
3. Projects that are Calendar Day;
4. When performing Work on the Critical Path;
5. When the Contractor has not provided proper justification and the Project Manager has not approved the request;
6. The Work obstructs the Traveled Way; or,
7. For issues for which the Contractor is responsible.

Partial Suspension shall be lifted if the Contractor Works on Critical Path activities and the Project Manager shall commence the Contract Time count.

If completion of the Contract requires Extra Work that impacts the Critical Path, the Contractor shall provide the Department an updated progress schedule and narrative requesting additional Contract Time associated with the Extra Work. Upon adequate justification by the Contractor the Department will determine if any adjustment in Contract Time is warranted.

Any request for additional Contract Time shall be made in writing to the Project Manager. If the Project Manager rejects a time extension request, the Contractor may proceed pursuant to Section 105.19, "Notice of Intent to Claim."

108.7 Reserved

108.8 LIQUIDATED DAMAGES

The Department is entitled to assess liquidated damages for failure of the Contractor to complete the Work within the Contract Time. A daily charge will be made against the Contractor not as a penalty, but as liquidated damages, for each Day for any Work that remains uncompleted after the lapse of Contract Time.

In suits involving the assessment or recovery of liquidated damages, the reasonableness of daily charges will be presumed and the amount assessed will be in addition to every other remedy enforceable at law, in equity, by statute, or under the Contract.

The Department does not waive its rights to assess liquidated damages under the Contract by allowing the Contractor to finish the Work after the expiration of Contract Time.

The Contractor shall complete the Work within the Contract Time. The Department's Contract administrative costs, including engineering, inspection, and supervision, will be increased as the time to complete the Work increases.

The Contractor agrees that the following schedule of liquidated damages, unless

otherwise specified in the Contract, represents an amount sufficient to cover estimated average daily Departmental costs if the Contractor does not complete the Project within the Contract Time and does not operate as a penalty to the Contractor:

**Table 108.8:1
Schedule of Liquidated Damages**

Total Original Contract Amount (\$)	Charge (\$) per Day
≤100,000	500
>100,000–500,00	1,000
>500,000–1,000,000	1,500
>1,000,000–2,000,000	2,000
>2,000,000–4,000,000	2,500
>4,000,000–7,000,000	3,000
>7,000,000–10,000,000	4,000
>10,000,000	5,000

The Department will deduct liquidated damages from the next Progress Payment due to the Contractor after Contract Time expires and will continue to assess liquidated damages each Progress Payment until the determination of Substantial Completion. If the Department directs Extra Work after Substantial Completion, the Department will rescind the determination of Substantial Completion and then assess Contract Time in accordance with Section 104.2, "Extra Work." If the amount of liquidated damages exceeds the monies due to the Contractor for that Progress Payment then the Department will seek reimbursement for any liquidated damages exceeding the dollar amount withheld from the Contractor.

If the Contractor has been granted Substantial Completion, but has not satisfied the requirements of Section 109.10, "Project Closure" the Department reserves the right to continue to assess liquidated damages until Physical Completion. Upon the completion of steps I through VII of Project Closure the ADE-Construction shall provide a written determination of Physical Completion to the Contractor which stops further assessment of liquidated damages.

108.9 DEFAULT OF CONTRACT

The Department may declare the Contractor in default of the Contract if the Contractor:

1. Fails to perform the Work with sufficient resources (supervision, workers, Equipment, or Materials) to assure the completion of the Work;
2. Performs the Work unsuitably, or neglects or refuses to remove Materials or to correct rejected Work;
3. Fails to begin the Work within the time specified in the Notice to Proceed;
4. Discontinues the Work;
5. Fails to resume discontinued Work after the Department issues a request to resume Work;
6. Becomes insolvent or is declared bankrupt, or files for reorganization under the bankruptcy code, or commits any act of bankruptcy or insolvency, either voluntarily or involuntarily;
7. Allows a final judgment, in a suit filed in connection with this Contract, to stand unsatisfied for 30 Days;

8. Makes an assignment, in connection with the Contract, for the benefit of its creditors;
9. Fails to carry on the Work in an Acceptable manner in accordance with the Contract;
10. Fails to comply with Contract requirements or willfully violates any term or condition of the Contract;
11. Fails to perform the Work or maintain the Project in compliance with Federal and New Mexico Occupational Health and Safety laws and regulations;
12. Fails to observe or comply with Federal and New Mexico laws and regulations, local laws and ordinances,
13. Is debarred or suspended in accordance with the Section 102.3, "Suspension and Debarment", or is suspended or debarred by any federal agency;
14. Communicates that the Contractor may not perform under the Contract;
15. Fails to promptly pay a Subcontractor or Supplier for undisputed Accepted Work in accordance with Section 108.1 "Subcontracting"; or,

The complete default process is sequential and consists of the following steps:

1. Notice of Apparent Default;
2. Declaration of Default and Demand for Surety to Complete the Work; and,
3. Department Completion of the Work.

108.9.1 Notice of Apparent Default

The Project Manager will provide written notice to the Contractor and the Contractor's Surety specifying the condition(s) in Section 108.9, "Default of Contract" that the Contractor violated and the corrective measures to be taken by the Contractor. If the Contractor or Surety does not proceed with the corrective measures within ten (10) Days of the date written notice, the Department, has full power and authority, without violating the Contract, to declare the Contractor in default.

108.9.2 Declaration of Default and Demand for Surety to Complete the Work

The written declaration of default is separate from the notice of apparent default and will be addressed to both the Contractor and the Surety. The declaration of default is issued after time for the Contract to take corrective measures expires in Section 108.9.1, "Notice of Apparent Default." The declaration of default removes the corrective measures from the Contractor, and will demand compliance by the Surety of the terms, conditions, and obligations contained in the Performance Bond.

If the Department determines that the Contractor is in default the Surety shall complete the Work at its own expense pursuant to the Contract and receive the balance of any funds owed to the Contractor.

108.9.3 Department Completion of the Work

If the Surety fails to complete the Work, the Department will complete the Work. The Department will deduct costs and charges that the Department incurs as a result of the default and the cost of completing the Work from Contract funds due to or which may become due to the defaulting Contractor or Surety. If the total costs for completing the Work exceeds the amount that would have been payable under the Contract, the defaulting Contractor and the Surety shall be jointly and severally liable for the excess costs.

If a default of the Contractor is later determined to be without cause, the default of the

Contractor will revert to a Section 108.10, "Termination of Contract; No Fault of Contractor," and the Contractor is not entitled to recover damages other than those allowed by that section.

108.10 TERMINATION OF CONTRACT; NO FAULT OF CONTRACTOR

The Department may terminate, by written notice and order, all or part of the Contract, after determining the following:

1. That the Contractor is prevented from proceeding with or completing the Work as originally contracted for reasons beyond the control of the Contractor; or,
2. That termination would be in the public interest.

Reasons for termination may include, but are not limited to, the following:

1. Executive orders of the President of the United States;
2. Executive orders of the Governor of the State of New Mexico;
3. An emergency that creates a serious shortage of Materials, as deemed by the Secretary;
4. Orders from duly constituted authorities relating to energy conservation;
5. Restraining orders or injunctions obtained by third party citizen actions resulting from national or local environmental protection laws or where the issuance of the order or injunction is primarily caused by acts or omissions of persons or agencies other than the Contractor; or,
6. To correct any Material errors or omissions or to correct any discrepancy or contradictions within the Contract discovered after execution of the Contract by both parties, the failure of which to correct is likely to lead to Contractor Delay, a Claim for additional time, or a Claim for compensation which may exceed the costs recoverable under this Section.

108.10.1 Submittals and Procedures

When the Department issues a notice and order for a Contract termination effective on a certain date the Department will pay:

1. For the actual number of units or items of Work completed at the Bid Item Unit Price;
2. For items of Work started but not completed as negotiated and mutually agreed. Negotiated amount shall not exceed the Bid Item Unit Price; and,
3. For invoices to restock or for invoices for Material on hand for Work not yet started. Invoices shall be provided by the Contractor documenting both costs and Department will make a determination on how to proceed, including delivery of the Material if needed. For the purposes of this section, Materials on hand are Materials that are ordered and have been manufactured before the date notice and order of termination is issued.

After the Contractor receives the termination notice and order from the Department, and no agreement or only a partial agreement is reached about the termination costs, then Contractor shall submit any Claim for damages or costs within 30 Days of the date of the notice and order of termination or shall waive such Claim. The Contractor shall submit the Claim in accordance with Sections 105.19, "Notice of Intent to Claim" and 105.20, "Administrative Remedy." The Claim shall be limited to the following cost items:

1. Actual and direct bidding and Project investigative costs which are separate and excluded from home office overhead costs;
2. Actual and direct mobilization costs, mobilization paid by the Department exceeding

actual and direct mobilization costs may be subject to reimbursement by the Contractor;

3. If Work is stopped in advance of the termination date, idle Equipment time using standby-time rental rates at 50% of the Blue Book Equipment rental rate, without the cost of operating personnel;
4. If Work is stopped in advance of the termination date, idle labor costs;
5. Unpaid Supplier costs;
6. Accounting charges involved in Claim preparation;
7. Written and executed agreements for private land usage; and,
8. An additional ten percent (10%) of the total of the above items 2, 3, 4, and 5 to cover home office overhead and salaried labor expenses.

The Contractor shall provide those records required by Section 105.20.1, "District Level," to the Department to determine the validity and amount of each Claim item. The Contractor shall not be entitled to recover anticipated loss of profits or any category of damages excluded pursuant to Section 109.11, "Compensation for Claims."

Full or partial Contract termination does not relieve the Contractor of its contractual responsibilities for the completed Work, nor will it relieve the Surety of its obligation for Claims arising out of the completed Work.

SECTION 109: MEASUREMENT AND PAYMENT

109.1 MEASUREMENT OF QUANTITY

The Department will measure Pay Items in accordance with the Pay Unit listed in the Contract.

109.1.1 Pay Unit Terminology

Otherwise, the following terminology controls:

1. The distance between stations is 100 feet, measured longitudinally;
2. Longitudinal measurements are along and parallel to surfaces, not horizontal. For pay items measured by the square yard, the Department will make no deduction for fixtures in the Work with areas less than one (1) square yard;
 - a. Transverse measurements for areas of Base Course and pavements are the neat line dimensions shown on the Plans based on the average width of the installed Material along the centerline of the Roadway;
 - b. Structures are measured according to the neat lines shown on the Plans or as provided by the Department;
 - c. For pay items measured by the foot, measurements are parallel to the base or foundation;
3. The volume of excavation is calculated by using the average end area method at 25 foot intervals or other Project Manager approved methods;
4. A ton equals 2,000 lb; a "sack" equals 94 lb of cement;
5. Timber and lumber (permanently incorporated in the Project) is measured by the foot, and measured on nominal widths and thickness and the length of each piece. The Department will Accept lumber and timber conforming to the American Lumber Standards for rough and dressed sizes, as specified in the Contract;
6. Standard manufactured items, identified by unit weight or section dimensions, are measured using nominal weights or dimensions. The Department will Accept manufacturing tolerances established by the industries involved, unless otherwise stated in the Contract;
7. Asphalt Materials are measured by the ton or as designated in the Contract. The weight is based on net certified scale weights or weights calculated from certified volumes. The certified weights or volumes are subject to inspection and adjustment at the point of delivery;
8. Materials that are measured by weight shall be measured and proportioned by weight using certified and accurate scales that are within tolerances established by state law;
 - a. The Contractor shall provide scales or use commercial scales;
 - b. Scales shall be certified and sealed at least once every 12 months or each time the scales are relocated, or as directed by the Project Manager;
 - c. Weighmasters (including Deputy Weighmasters), provided by the Contractor and certified by the NMDA, shall operate the scales. The certified weighmasters shall perform their duties in accordance with the regulations of the New Mexico Department of Agriculture statutes and regulations concerning the same. The cost of the certified weighmasters, weighmasters' scales, scale tickets, scale house, and verification of the scale's accuracy is Incidental to the weighed Material;

- d. Empty vehicles used to haul Material paid by weight shall be weighed at least twice daily, at a minimum once prior to initial Material delivery and once prior to final Material delivery. The Contractor shall ensure vehicles bear legible identification marks. On a daily basis the Contractor shall provide the Project Manager with a written list of delivery vehicles showing identification marks, number of axles, the distance between extreme axles and daily tare weights. The Contractor shall update this information before delivery of the Material and when the Contractor changes vehicles, combination vehicles, or axle length relationships;
- e. The Department may convert weight to volume, or volume to weight, for payment purposes. The Project Manager will determine the factor(s) for conversion using an Acceptable method;
- f. The operator of each weighed vehicle shall obtain a scale ticket (certificate of correct weight) from the weighmaster and deliver the ticket to the Project Manager or designee at the point of delivery. The following information shall be included on the scale ticket:
 - i. Project number;
 - ii. Date;
 - iii. Ticket number;
 - iv. Truck / Trailer unit number;
 - v. Gross weight;
 - vi. Tare weight;
 - vii. Net weight;
 - viii. Material type;
 - ix. Certified weighmaster's name;
 - x. Signature of weighmaster; and,
 - xi. Whether the driver was on or off the scale during weighing.

109.2 APPROVED EQUIPMENT RENTAL RATES

For machinery or Equipment owned or leased directly by the Contractor or its Subcontractor at any tier, the Contractor will be paid Equipment rental rates as designated in the Contract. The Department will not compensate the Contractor or its Subcontractors at any tier for owned or leased small tools. Small tools are defined as any tool which would be valued less than \$2000.00 if purchased new.

The Blue Book rates shall be used for the actual time the Equipment is in operation calculated by using the Federal Highway Administration rate. The FHWA rate is equal to the monthly rate divided by 176 (hours/month) plus the hourly operating cost. The FHWA rate must also be adjusted for age and geographic region. Therefore, the "FHWA" rate in the Blue Book represents monthly rate/176 x age adjustments x regional adjustments plus hourly operating cost. The Department may add a maximum of 10% only to the Equipment rental rates. The Department will apply Equipment rental rates pursuant to the Blue Book and in accordance with the following criteria:

- 1. The manufacturer's identification plates on the Equipment will be used to identify the Equipment and its capacities. If the Equipment does not have these plates, the Contractor shall provide written statements certifying the Equipment identification and capacity as shown on the Contractor's Equipment inventory. The Contractor shall submit the type, capacity, and horsepower of each piece of Equipment, to

correlate with the Blue Book schedule. The Blue Book reflects the maximum rates for Equipment of modern design and in good-working condition;

2. The Blue Book lists common pieces of Equipment. If the Blue Book does not list a piece of Equipment the use of the Blue Book rental rate for a comparable piece of Equipment shall be used as approved by the Project Manager. If no comparable piece of Equipment is identified in the Blue Book the Project Manager may negotiate a rental rate with the Contractor at a fair market rental rate;
3. If a piece of Equipment, not available on the Project, requires hauling onto the Project, the Contractor shall include the actual transportation cost (in and out). The Department will pay the transportation cost for each piece of Equipment once. Under unusual circumstances the Contractor may provide to the Department written justification for additional transportation costs;
4. The Contractor shall only be paid the operating rate for those hours the Equipment is actually in use. A standby rate for Equipment required to be at the Work site but not operating may be paid by the Department if agreed to in writing in advance by the Project Manager in which case the Department will pay for standby Equipment using standby-time rental rates at 50% of the Blue Book Equipment rental rate, without the cost of operating personnel;
5. The regional difference percentage, as described in the Blue Book does not apply. However, the factors in the Rate Adjustment Tables of the Blue Book do apply; and,
6. Overtime, as described in Blue Book does not apply. The Department will pay for Equipment used on Extra Work at the regular hourly rate in accordance with the rate provided in the Blue Book.

109.3 SCOPE OF PAYMENT

The Contractor shall receive and Accept compensation in accordance with the Bid for performing the Work in an Acceptable manner. The compensation associated with the Bid shall include the risks, losses, damages and expenses that, when considering the nature of the Work and having exercised Pre-Bid Due Diligence, should have been reasonably expected by the Contractor in prosecuting the Work.

The Contractor shall receive and Accept compensation provided for in the Contract as full payment for furnishing all Materials and for performing all Work under the Contract in a complete and Acceptable manner subject to the provisions of Section 107.26, "No Waiver of Legal Rights." The Contractor's Bid Item Unit Price is presumed to be based on its exercise of Pre-Bid Due Diligence and considers all risk, loss, damage, or expense of whatever character arising out of the nature of the Work.

The Department will pay for the approved actual quantities of Material incorporated into the Work unless otherwise provided in the Contract.

The Department will only pay for Pay Items listed in the Contract in accordance with the "Basis of Payment" provisions. Items not included in the "Basis of Payment" provisions shall be considered Incidental, unless otherwise indicated in the Contract. The Department will not pay separately for Work Incidental to the completion of a Pay Item, or pay for the Incidental Work under another Pay Item; except as provided in Section 104.6, "Rights in and Use of Materials Found on the Work."

Payment for any Pay Item shall be full compensation for all Work necessary to complete the Pay Item.

When a Contract Item Specification references another Specification(s) to complete the Work, Pay Items referenced in that Specification, the Pay Items referenced will not be measured or paid for separately. For example, if the Specification for Contract item "A" refers to Specification "B" the Pay Items in Specification "B" will not be paid for, unless specifically stated in the Contract. The Payment for Contract item "A" will be full compensation for Work as described in the Specification for Contract item "A".

The Contractor shall not receive payment for corrective Work. Corrective Work is Work required by the Department to make previously unacceptable Work Acceptable.

The Department may Accept portions of the Work at an adjusted price in accordance with the relevant Pay Adjustment provisions in the Contract. The adjusted price only applies to the specific Accepted portion of Work.

109.4 COMPENSATION FOR OVERRUN / UNDERRUN QUANTITIES

When the Project Manager determines the Work is Acceptable, the Department will pay the Contractor in accordance with Basis of Payment section or Change Order. If the Accepted quantities of Work vary from the quantities in the Contract, the Contractor shall Accept, as payment in full, payment based on the Bid Item Unit Price for the Accepted quantity.

109.5 PAYMENT FOR EXTRA WORK

The Department will pay the Contractor for Extra Work resulting from significant changes in the character of the Work, differing site conditions or Department ordered Work based on the following order of priority for payment:

1. Bid Item Unit Prices;
2. Negotiated unit prices;
3. Negotiated Lump sum; or,
4. Force Account.

For Items of Work performed by the Contractor, the negotiated unit price or negotiated Lump sum price shall include all costs associated with the Work. If Subcontractors perform Work as Extra Work under items 2, 3 or 4, the Department may only compensate the Contractor up to an additional ten percent (10%) of the total actual cost of the subcontracted Work less than or equal to \$10,000.00 for indirect and administrative costs. If the total cost of the subcontracted Work is greater than \$10,000.00 then the Department shall only compensate the Contractor \$1,000.00 plus five percent (5%) of the excess over \$10,000.00.

109.6 FORCE ACCOUNT

When the order of priority for payment is exhausted and Extra Work must be paid by Force Account, the Department will pay the Contractor in accordance with the following Sections.

If the total cost of the subcontracted Work by Force Account is less than or equal to \$10,000.00, then the Department shall only compensate the Contractor an additional ten percent (10%) of the total cost of the subcontracted Work for indirect and administrative costs. If the total cost of the subcontracted Work is greater than \$10,000.00, then the Department shall only compensate the Contractor \$1,000.00 plus five percent (5%) of the excess over \$10,000.00.

109.6.1 Labor

The Department will pay the wage rate for Force Account Work actually paid by the Contractor during the pay period ending before the Force Account Work commences. Such payment shall include Work by supervisors in direct charge of the Force Account Work. If there is no wage rate for a labor classification needed to perform the type of Work required, the Department and Contractor will negotiate and document a new wage rate before beginning the Force Account Work.

Labor shall also include, and the Department will reimburse for, the following actual reasonable costs paid to (or on behalf of) workers:

1. Subsistence and travel allowances that do not exceed the New Mexico Per Diem and Mileage Act or other Department approved per diem rates;
2. Health and welfare benefits;
3. Retirement fund benefits;
4. Vacation benefits; and,
5. Other benefits required by collective bargaining agreements or other employment Contract, applicable to the class of labor.

The Department will pay an amount equal to 30 percent of the sum of the direct labor costs and fringe benefits. This payment is in compensation in the following increments: field office overhead (10 percent), home office overhead (10 percent), and profit (10 percent).

109.6.2 Bond, Insurance, and Tax

The Department will pay the Contractor either:

Option 1

The actual cost of the following, plus six percent (6%):

1. Property damage, liability, and worker's compensation insurance premiums;
2. Unemployment insurance premiums or contributions;
3. Applicable payroll taxes (not including gross receipts taxes); and,
4. Social Security taxes.

To recover actual costs, the Contractor shall provide actual invoice costs of the rate(s) it has paid for bonds, insurance, and taxes.

Option 2

In lieu of supplying the above evidence and recovering actual costs:

1. The Contractor shall receive payment at a rate representing 30% of the labor costs for labor burden; and
2. The Contractor shall also receive payment for the additional costs to Contract Bonds supported by invoice(s).

109.6.3 Materials

The Department will pay the Contractor the actual cost of Materials Accepted by the Project Manager and incorporated into the Force Account Work, including transportation charges paid by the Contractor (exclusive of Equipment rentals), plus 15% of the Material cost.

109.6.4 Equipment

For special Equipment (other than small tools as defined by the Blue Book), including fuel and lubricants and transportation costs, the Department will pay rental rates as determined in accordance with Section 109.2, "Approved Equipment Rental Rates," unless otherwise agreed in writing.

109.6.5 Miscellaneous

The Department will not pay for other costs not specifically addressed in Section 109.6, "Force Account."

109.6.6 Documentation

The Project Manager will use the Department approved forms to track Force Account costs. The Contractor shall compare and reconcile records with the Project Manager daily, or as otherwise directed by the Project Manager, to determine the amount of Force Account Work completed by the Contractor.

109.6.7 Statements

The Department will not pay for Force Account Work until the Department verifies that the Force Account Labor, Material, and Equipment forms are supported by the documents below. The Contractor shall furnish the Project Manager with itemized statements of the cost of the Force Account Work detailed as follows:

1. Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman;
2. Attachments verifying Equipment brand, year of manufacture, operating Specifications, dates of use, daily hours, total hours, current Blue Book rental rate, and rate of applicable attachment for each piece of Equipment;
3. Quantities of Materials and prices; and,
4. Transportation of Materials.

Statements shall be supported by receipted invoices for all Materials used and for transportation charges. For in-stock Materials or Materials furnished by the Contractor, the Contractor shall provide an affidavit certifying that such Materials were taken from the Contractor's stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor. This requirement does not waive the Contractor's responsibility to provide Certificates of Compliance per Section 106.4, "Certificates of Compliance."

The total payment made as provided above shall constitute full compensation for Force Account Work authorized in writing by the Department.

109.7 ELIMINATED ITEMS

Should Pay Items contained in the Contract become unnecessary for the reasonable completion of the Work, the Project Manager may direct the Contractor, in writing, to eliminate Pay Items from the Contract. This written notification will not invalidate the Contract. The Department will reimburse the Contractor for actual Work completed before the written notification at Bid Item Unit Price.

The total cost of return freight, handling, and restocking for Materials associated with that eliminated Work will then be increased by 15%. If Materials cannot be returned, the Department will pay for said Materials at Contractor's actual cost and take ownership.

109.8 PROGRESS PAYMENTS

The Contractor shall not construe any Progress Payment to be an Acceptance of any defective Work or improper Material.

The Acceptance of Work for the purposes of Progress Payments does not constitute Final Acceptance of the Work.

The Department will make Progress Payments once each month. The Project Manager will prepare and post Progress Payments based on estimates of the value of the Work performed and Materials complete-in-place, and in accordance with Section 109.9, "Stockpile" and minus price reductions within five (5) Days of the estimate cut-off date.

The Department will include monies associated with an Accepted and fully executed Change Order when the Work is Accepted with the next Progress Payment.

The Project Manager shall process a Progress Payment on a monthly basis regardless of the dollar amount, including zero dollar (\$0.00), owed the Contractor.

The Department has the authority to withhold Progress Payments in part or in their entirety as part of a suspension.

109.8.1 Retainage

The Department will make Progress Payments to the Contractor in accordance with Section 109.8, "Progress Payments." The Department will pay 100% of the value of Work performed and Materials complete in place in accordance with Section 109.9, "Stockpile," until the sum of the Progress Payments made equals 95% of the Total Original Contract Amount as amended by Change Order. The Department will continue to make additional Progress Payments in the sum of zero dollars (\$0.00) after the Total Original Contract Amount as amended by Change Order equals 95% and until the Contractor completes the Work in an Acceptable manner. The five percent (5%) retained when the Progress Payments equals 95% of the Total Original Contract Amount as amended by Change Order is the amount considered necessary to protect the interests of the public and the Department; those interests include ensuring that the Work is Acceptable, on schedule, in compliance with the Contract, and that the Work reaches Substantial Completion and Final Acceptance. Subject to other deductions the amount retained shall be provided to the Contractor in accordance with Section 109.10, "Project Closure."

109.8.2 Non-Conformance

If the Contractor fails to comply with all Material terms and conditions of the Contract the Department may withhold an additional 25% as a Non-Conformance from each Progress Payment and subsequent Progress Payments in addition to Retainage until the Contractor fully complies with the Contract. Release of Non-Conformance withholdings shall be processed at the next scheduled Progress Payment after the resolution of the Non-Conformance.

Nothing in this section prevents the Department from withholding application and certification for payment because of the following: unsatisfactory job progress, defective construction not remedied, disputed Work, third party Claims filed or reasonable evidence that a Claim will be filed, failure of the Contractor to make timely or prompt payments for labor, Equipment, and Materials, damage to the Department, reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract, or for Retainage.

The Contractor is not entitled to late payment charges, including late payment charges pursuant to NMSA 1978, § 13-1-158, associated with any payment retained under this Section.

109.8.2.1 Automatic Non-Conformance

These items do not follow the Potential Non-Conformance process below. The failure to comply will automatically result in the issuance of a Non-Conformance and withholding of an additional 25% as a Non-Conformance from each Progress Payment. The following items shall be provided in the timeframes in their respective section:

1. The Certificate of Compliance per Section 106.4, "Certificates of Compliance" for Materials that are required to be Buy America compliant per Section 106.12, "Buy America Requirements;"
2. Schedule submittals within the timeframes in Subsection 108.3, "Schedule;"
3. Prime Contractor's certified payrolls complete submittal within the timeframe in the "Federal Requirements" Notice to Contractors; and,
4. The Contractor's prompt payment to its Subcontractor for undisputed Accepted Work.

109.8.2.2 Potential Non-Conformance

For all other terms of the Contract, that the Contractor fails to comply with the Department will issue a Notice of Potential Non-Conformance. The Notice of Potential Non-Conformance will be issued on the current Department form and the Contractor shall have five (5) Days after the Progress Payment cutoff date to resolve the issues listed on the form.

If the Contractor resolves all issues on the Notice of Potential Non-Conformance within five (5) Days after the Progress Payment cutoff date then no action to withhold the 25% Non-Conformance amount is taken by the Department. If the Contractor does not resolve each issue on the Notice of Potential Non-Conformance within five (5) Days after the Progress Payment cutoff date then the Department will withhold an additional 25% as a Non-Conformance from each Progress Payment and subsequent Progress Payments in addition to Retainage until the Contractor fully complies with the Contract.

For Safety Items the Department will include a timeframe to resolve the issue in the Notice of Potential Non-Conformance that may be other than five (5) Days after the Progress Payment cutoff date. If the Contractor fails to resolve the safety issue in the Notice of Potential Non-Conformance in timeframe then the Department will withhold an additional 25% as a Non-Conformance from each Progress Payment and subsequent Progress Payments in addition to Retainage until the Contractor fully complies with the Contract.

109.9 STOCKPILE

Only items identified in the Notice to Contractors titled "Stockpile" are eligible for Stockpile payment.

109.9.1 Stockpile Payment

After measurement, partial (stockpile) payments to the Contractor may be made for Items on hand not to exceed 50% of the Bid Item price under the following conditions:

1. The Items will be incorporated in the Work;

2. The Items are delivered to the Project or to a storage place approved by the Project Manager;
3. The delivered Items meet the requirements of the Contract, including Certificates of Compliance per Section 106.4, "Certificates of Compliance;" and,
4. The Contractor submits paid invoices, certified by the Supplier or Fabricator, to the Project Manager.

109.10 PROJECT CLOSURE

- | | |
|------------|---|
| Step I. | Contractor Notice of Projected Substantial Completion Date |
| Step II. | Completion Conference |
| Step III. | Termination of Contract Time |
| Step IV. | Project Inspection and Development of Punch List |
| Step V. | Notice of Punch List Completion and Request of Final Inspection |
| Step VI. | Final Inspection |
| Step VII. | Contractor Submittal of Final Documentation |
| Step VIII. | Physical Completion and Release of Retainage and Final Payment |

109.10.1 Contractor Notice of Projected Substantial Completion Date

The Contractor shall provide written notification to the ADE-Construction of the projected Substantial Completion date. This notice shall be provided a minimum of 30 Days prior to the projected date unless otherwise approved by the Project Manager.

109.10.2 Completion Conference

Prior to the projected Substantial Completion date, the ADE-Construction and the Project Manager shall conduct a completion conference with the Contractor to review the Project and determine conformance with the Contract. The Department and Contractor will address all outstanding Work needed for Substantial Completion. The Department and Contractor will agree on the schedule for completion of all Work necessary for Project Closure pursuant to Section 109.10, "Project Closure."

Within five (5) Days of the completion conference or as directed by the Project Manager the Contractor shall submit for approval by the Project Manager the Contractor's proposed updated schedule for Project Closure.

109.10.3 Termination of Contract Time and Determination of Substantial Completion

After the steps I and II of Project Closure are complete and the Contractor has determined it is ready to request Substantial Completion, the Contractor shall provide to the ADE-Construction a written request to determine Substantial Completion. Within two (2) Days of receipt of the request for Substantial Completion the ADE-Construction will issue a determination of Substantial Completion, Contract Time or, if applicable, Liquidated Damages assessments will cease upon Substantial Completion.

109.10.3.1 Rescinding Substantial Completion

The Department may rescind Substantial Completion by written notice when any of the conditions for Substantial Completion in the definition of Substantial Completion are no longer met. Substantial Completion may also be rescinded by the Department when Department Ordered Work per Section, 104.2.3 "Department Ordered Work" is required.

109.10.4 Project Inspection and Development of Punch List

The Project Manager shall inspect the Project to verify that all Work is complete or develop Punch List items upon the determination of Substantial Completion. The Project Manager shall provide the Contractor written notice that all Work is complete or shall provide a Punch List. Contract Time shall resume if the Contractor fails to provide Acceptable Work associated with the Punch List within the agreed upon schedule that shall not exceed thirty (30) Days and resumed Contract Time shall continue until all Punch List Work is Accepted.

109.10.5 Notice of Punch List Completion and Request of Final Inspection

The Contractor shall provide written notification to the Project Manager that the Punch List is complete and request final inspection.

109.10.6 Final Inspection

The final inspection by the Project Manager and the ADE - Construction will be scheduled and conducted within five (5) Days of the Contractor's written request for final inspection. If the inspection reveals unacceptable or unsatisfactory Work, the Project Manager shall give the Contractor written instructions for correction and set the time limit for the Contractor to comply with these instructions. Upon the Contractor's correction of the Work, written notification shall be provided to the Project Manager, the Project Manager shall make an additional inspection and notify the Contractor within four (4) Days of the findings.

If the Project Manager and the ADE - Construction are satisfied that the Work is complete and Acceptable, that inspection shall constitute the final inspection. The Project Manager shall provide written notification of the final inspection Acceptance to the Contractor within four (4) Days.

The Department will Accept the Project as soon as practicable after completion and inspection of the Work. Acceptance is final and conclusive, except for the following situations:

1. Latent defects;
2. Fraud;
3. Gross mistakes that amount to fraud; or,
4. The Department's warranty or guaranty rights.

109.10.7 Contractor Submittal of Final Documentation

The Contractor shall submit a schedule for submittal of the following documents required by the Contract including the Final Payment Voucher, Certificate of Payment of Claims, Summary to Contractor, Pit Release Letter, additional named insured Insurance Bonding Release, Affidavit of Wages Paid, and Surety Release within five (5) Days of the date of the written notice of final inspection Acceptance. For the Pit Release Acceptance by the Project Manager of a letter of intent from the landowner for future use may exempt haul Roads or other areas from their vegetation requirements.

The Contractor shall furnish a completed Certificate of Payment of Claims form from persons or firms, including the Contractor, who have filed Claims for additional compensation, for labor performed, or for Material, supplies, or services furnished to the Contractor or its Subcontractors.

The Department shall withhold final payment and no late payment interest shall be due for the withheld payments until the Contractor furnishes all documents required by the Contract.

109.10.8 Physical Completion, Release of Retainage, Final Payment and Final Acceptance

Upon the completion of steps I through VII of Project Closure the ADE-Construction shall provide a written determination of Physical Completion to the Contractor. The Department shall not release retained amounts until Physical Completion and when the Contractor fully complies with all Contract requirements.

Until Physical Completion of the Project, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof, by the action of the elements or from other causes, whether arising from the execution or from the non-execution of the Work.

The Department shall prepare an estimate summary to the Contractor which is used for the proposed final payment voucher. The proposed final payment voucher shall correct all prior Progress Payments and release Retainage. The Department shall withhold from the proposed final payment voucher liquidated damages and overpayments. The Contractor shall sign, approve and return the Department's final payment voucher. Upon receipt of a signed and approved final payment voucher the Department shall Accept the Work and pay the balance due on the final payment voucher. The Department paying the balance due on the final payment voucher constitutes Final Acceptance.

If the Contractor disputes the final payment voucher, then the Contractor shall submit the Notice of Intent to Claim form within seven (7) Days of receipt of the final payment voucher. The Contractor shall not change or modify the final payment voucher. If a clerical error on the final voucher is discovered the Contractor shall notify the Project Manager in writing before the seven (7) Day expiration. If the Project Manager agrees that there is clerical error, the Project Manager will correct the error and reissue the final payment voucher. If the Project Manager does not agree the Project Manager shall notify the Contractor in writing and the Contractor shall have seven (7) Days of receipt to sign the final payment voucher or submit a Notice of Intent to Claim. If the Contractor submits a Notice of Intent to Claim form or the timeframe to submit the Notice of Intent to Claim form expires, the Department shall Accept the undisputed Work, pay the undisputed balance unilaterally due on the final payment voucher. A Claim is forever barred if the Claim is not timely and properly submitted pursuant to Section 105.19, "Notice of Intent to Claim" within seven (7) Days of receipt of the Department's proposed final payment voucher. The Department paying the balance due on the final payment voucher constitutes Final Acceptance.

Upon Final Acceptance the Department will complete its administrative process to close the Project. Project Closure occurs when the State Construction Engineer or designee signs the compass form.

109.10.9 Department Requests for Reimbursement or Refund

The Contractor shall reimburse or refund the Department for any overpayment in response to a request for refund of overpayment within 30 Days of the Department's request. Failure by the Contractor to comply may subject the Contractor to default and to rejection of the Contractor's Bids in accordance with Section 102.5, "Rejection of Bids," until such time that Contractor complies with this Section.

109.11 COMPENSATION FOR CLAIMS

The Contractor is not entitled to late payment charges, including late payment charges pursuant to NMSA 1978, § 13-1-158, associated with any Claim or disputed construction services and Materials. The Department will pay the Contractor late payment charges as authorized by NMSA 1978, § 13-1-158 for construction services and Materials not the subject of a disputed Claim or subject to Retainage or withheld Progress Payments and that have been certified by the Department to have been received and Accepted. The Department will pay the Contractor late payment charges on undisputed, qualified, Delayed Progress Payments for certified, approved and Accepted Work in accordance with Section 109.8, "Progress Payments" that are not the subject of a disputed Claim.

The Contractor is barred from seeking a Claim, a remedy, compensation, time, cause of action, or any damages except as provided by Section 105.19, "Notice of Intent to Claim," and Section 105.20, "Administrative Remedy," and this Section.

The Contractor shall not be entitled to any consequential, indirect, punitive, exemplary, special, or incidental damages. When the Department determines entitlement the Contractor shall only receive additional compensation and time as specifically provided by the following Sections of these Specifications: Section 104.2.1, "Significant Change in the Character of the Work;" Section 104.2.2, "Differing Site Conditions;" Section 104.2, "Extra Work;" Section 107.10.3, "Cooperation with Owner of Railroad Right of Way;" Section 107.20, "Contractor's Responsibility to Protect the Work;" Section 108.6, "Determination and Extension of Contract Time;" Section 108.10, "Termination of Contract; No Fault of Contractor;" Section 109, "Measurement and Payment;" and this Section.

Except as otherwise agreed to by the Contractor and the Department in a written Change Order, all Claims and causes of action arising out of the performance and administration of the Contract shall be governed by this Section including: Claims for Delay, Claims for additional compensation and time, Contract adjustment, Claims seeking extension of Contract Time, Claims seeking Delay damages, pass-through Subcontractor Claims, causes of action for breach of Contract, promissory estoppel, equitable estoppel, waiver, detrimental reliance, bad faith breach of Contract, breach of the covenant of good faith and fair dealing, or any other cause of action arising out of the performance of the Work or the Contract. The compensation, time and damages provided for in this Section are exclusive, complete, and apply regardless of whether such Claims are to be resolved pursuant to the procedures set forth in Section 105.20, "Administrative Remedy," or any other legal or administrative procedure, whether or not authorized herein, including arbitration, mediation, or appeal.

109.11.1 Non Critical Disruption

Non-critical Disruption is a disruption or interference with Contractor's performance, regardless of cause, that does not negatively impact the Critical Path of the Project and therefore does not meet the definition of a Delay and for which the Contractor will not be entitled to receive Delay compensation per Section 109.11.2.2, "Additional Time for Delay."

109.11.2 Delay

"Delay", in this section, does not include time extensions granted by the Department by Change Order in accordance with Section 108.6, "Determination and Extension of Contract Time" that do not result in any additional compensation.

The Contractor's entitlement to compensation and time for a Delay is defined, limited to, and provided as follows:

1. Excusable Delay: A Delay which is beyond the Contractor's control that negatively impacts the Critical Path of the Project and is not caused, by the Contractor's fault or negligence and for which compensation and/or a time extension may be granted, based upon the following:
 - a. Excusable Compensable Delay: An Excusable Delay that negatively impacts the Critical Path of the Project resulting from the neglect or default of the Department or from a differing site conditions per the section for differing site conditions. For such Delays, the Department may grant additional time and compensation. Examples of an excusable Compensable Delay may include but are not limited to Delays attributable to design errors or a differing site condition not readily discovered through Pre-Bid Due Diligence, failure by the Department to acquire Right of Way, and Department-initiated design changes;
 - b. Excusable Non-compensable Delay: An unforeseen and unanticipated Excusable Delay not caused by the fault of either the Contractor or the Department that negatively impacts the Critical Path of the Project. For such Delays, the Contractor may receive an extension of time but not additional compensation. Examples of a Non-compensable Delay may include but are not limited to those events described in Subsection 107.20, "Contractor Responsibility."
2. Inexcusable Delay or Non-excusable Delay: A Delay for which the Contractor is not entitled to compensation and/or time that was caused by: factors within the Contractor's control; the fault or responsibility of the Contractor; factors that could or should have reasonably been foreseen by the Contractor; Delays caused by an event that the Contractor could have foreseen and prevented but failed to do so; or failure to reasonably mitigate additional Delay after an excusable Delay has been identified. Examples of inexcusable or non-excusable Delays may include but are not limited to those attributable to reasonably expected seasonal inclement weather events based on historical data, reasonable time periods necessary for reviews of shop drawings by the Department, inefficient operation by the Contractor or Subcontractor, inefficient or ineffective construction management by the Contractor or Subcontractor, failure to assign sufficient resources to the Project by the Contractor or its Subcontractor, failure by the Contractor to properly perform Pre-Bid Due Diligence, or failure by the Contractor, Subcontractor or Supplier to procure Materials in a timely manner.
3. Concurrent Critical Delay: Concurrent Delay only occurs when the Project has two (2) separate Critical Paths that have two (2) separate Delays which start and end on the same date, delaying the Project for the same amount of time. For Delays that start on the same date but are resolved at different dates the Contractor is not entitled to any time or additional compensation for the duration when a non-excusable or inexcusable Delay occurs on either of the Critical Paths. When an excusable compensable Delay and excusable non-compensable Delay are concurrent as defined above the Contractor shall only be entitled to Contract Time and not any additional compensation.

109.11.2.1 Additional time for Delay

The Department may only add Contract Time for an Excusable Compensable Delay or an Excusable Non-compensable Delay using the Accepted updated monthly or revised schedules current and in effect at the time the Delay occurred.

109.11.2.2 Compensation for Delay

The Department may only compensate the Contractor for an excusable compensable Delay as provided in this Section and in the following order of priority and no other methods of

calculating compensation will be Accepted. In order to receive compensation for an excusable compensable Delay the Contractor shall document and provide costs resulting from the excusable compensable Delay using actual cost records, shall measure and provide expenses using generally Accepted accounting principles, and shall comply with Section 108.3.2, "Schedule Format," and if an agreement about the extension of Contract Time cannot be reached then the Contractor shall comply with Section 108.6, "Determination and Extension of Contract Time."

- I. The Department reserves the right to use innovative bidding approaches, as specified in the Contract, including requiring Bidders to bid a daily overhead rate (cost / Working Day) as a Bid Item Unit Price. For example the Contract may require that the Contractor escrow its Bid documents, and the escrow Bid Documents may be considered in resolving Claims.
- II. The compensation which the Contractor may recover for a Delay Claim is limited to:
 1. Non-salaried labor expenses;
 2. Material costs;
 3. Equipment costs pursuant to Section 109.2, "Approved Equipment Rental Rates;"
 4. Costs of extended job site overhead, including bonds; or,
 5. An additional ten percent (10%) of the total of items 1, 2, 3, and 4 to cover home office overhead, salaried labor expenses, and profit.
- III. If the source of the loss of productivity can be attributed to an excusable compensable Delay and cannot be isolated and priced separately, the method by which the Department shall calculate the extent of an excusable compensable Delay caused by a production rate inefficiency shall be made in the following order of priority:
 1. Measured Mile analysis by which the Department shall compare actual efficiency (production rates) in an impacted area to actual efficiency in a comparable non-impacted area; or,
 2. Comparison of actual productivity to production rates in the Contractor's Baseline Schedule and timely submitted Acceptable updated monthly or revised schedules or in the escrow bid Documents.

109.11.2.3 Non-Recoverable Damages

In no event shall the Contractor submit or be entitled to payment based on any of the following including but not limited to Eichleay formula, the Total Cost Method, original Contract period formula, fixed overhead formula, burden fluctuation method, and comparative absorption rates.

Regardless of the basis or cause of the Claim, the Contractor shall not recover and is not entitled to recover the following categories of damage:

1. Any compensation except as provided by Section 109.11.2.2, "Compensation for Delay;"
2. Loss of anticipated profit, incentives, or bonuses;
3. Labor inefficiencies at the fault of the Contractor;
4. Home office overhead regardless of whether it is characterized as absorbed, unabsorbed, or extended exceeding that provided in Section 109.11.2.2, "Compensation for Delays;"
5. Any damages, costs or expenses that are indirect, special, incidental or consequential, including, but not limited to, lost or impaired bonding capacity, loss of

Bidding and contracting opportunities, loss of credit standing, cost of financing, interest paid, lost Material discounts, economic loss, loss of reputation, loss of other Work, loss of use, loss of business opportunity, loss of product or output, income, loss of profit or revenue, cost of capital, financing, and for loss of management or employee productivity or of the services of such persons, and business devastation, bankruptcy, or insolvency. The Department waives any entitlement to consequential damages from the Contractor but not general damages including but not limited to liquidated damages as provided in the Contract;

6. Acceleration costs and expenses. The Contractor shall only be entitled to acceleration costs and expenses if the Department has expressly and specifically directed the Contractor in writing to accelerate the Work at the Department's expense, the Contractor completes the Work within the time directed by the Department, the Contractor actually incurs acceleration costs and expenses, and the Contractor provides verifiable documentation to support the acceleration costs and expenses;
7. Late payment charges, including late payment charges pursuant to NMSA 1978, § 13-1-158, associated with any Claim, or disputed construction services or Materials. The Contractor is also not entitled to late payment charges on any judgment or award made to the Contractor. This provision does not affect the Department's payment of late payment charges on undisputed, qualified, Delayed Progress Payments for certified, approved and Accepted Work in accordance with Section 109.11, "Compensation for Claims" that are not the subject of a disputed Claim;
8. Prejudgment or post-judgment interest related to or arising from any disputed Claim or on any Award made to the Contractor; or,
9. Attorneys' fees and costs, Claim preparation expenses, and litigation or other costs related to or arising from any disputed Claim, or prosecution thereof.

DIVISION 200 – EARTHWORK

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SECTION 201: CLEARING AND GRUBBING

201.1 DESCRIPTION

This Work consists of clearing, grubbing, scalping, removing, and disposing of vegetation and debris. This Work includes protecting vegetation designated to remain and removal or control of all State-listed noxious weed species identified in the Contract. Scalping includes the removal of Material such as brush, roots, sod, stumps, and the residue of agricultural crops.

201.2 MATERIALS

201.3 CONSTRUCTION REQUIREMENTS

201.3.1 General

The Department will establish Right of Way lines, Construction limits, and designate trees, shrubs, plants, and other items to remain. The Contractor shall comply with Section 620, "Selective/Non-Selective Herbicide Application" for herbicide application.

The Contractor shall remove and dispose of all refuse and non-organic Material from within the Project Limits. Surface debris, trees, stumps, roots, organic matter, and other obstructions that can be chipped or broken down to an appropriate size and readily blended into the topsoil during final stabilization may remain within the Project limits. When approved by the Project Manager, the Contractor may leave undisturbed stumps and other solid objects within the Roadway Prism that do not extend more than six (6) inches above existing ground and will be at least four (4) ft below the finished Subgrade elevation. The Contractor shall backfill and compact Material placed in stump holes and other voids in accordance with Section 203.3.5, "Embankments."

The Contractor shall prune low-hanging branches from trees or shrubs designated to remain and prune overhanging tree branches to provide a clearance 20 ft above the Roadway surface. Pruning of trees and shrubs shall be performed in accordance with American National Standards Institute (ANSI) A300 Standard Part 1 Pruning.

The Contractor shall confine operations including dragging, piling, and burning of debris to Department approved areas.

The Contractor shall remove or control all State-listed Class A noxious weed species within the Right of Way Project Limits as identified in the Contract in a manner that prevents their re-growth and spread. Herbicide use shall comply with all applicable Federal, State, County and Municipal regulations and ordinances." The Contractor shall comply with Section 620, "Selective/Non-Selective Herbicide Application" of the current New Mexico State Department of Transportation Standard Specifications for Highway and Bridge Construction for herbicide application.

The current New Mexico Noxious Weed List is available at:
<http://plants.usda.gov/java/noxious?rptType=State&statefips=35> .

201.3.2 Salvageable Timber

The Contractor shall fell and cut timber (to the specified length) in accordance with the Contract. The Contractor shall stack cut logs as directed by the Project Manager.

201.3.3 Scalping

The Contractor shall scalp before excavation or placement of Embankment and remove organic Material under pipe Culvert bedding, regardless of Embankment height.

201.3.4 Removal and Disposal of Material

The Contractor shall remove from the Right of Way, Materials that cannot be safely and properly disposed (burned or chipped) of within the Project, and dispose at locations outside the Project.

The Contractor shall obtain written permission from the owners of property used for debris Material disposal.

The Contractor shall burn Materials:

1. In accordance with applicable laws and regulations;
2. Under the constant care of competent watchmen; and
3. Without damage to items designated to remain on the Right of Way, surrounding property, or vegetative cover.

The Roadway and adjacent areas shall have a neat and finished appearance after any removal and disposal of Material. The Contractor shall not accumulate flammable Materials on or adjacent to the Right of Way.

201.4 METHOD OF MEASUREMENT

Clearing and grubbing will be measured as a Lump Sum unit.

201.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Clearing and Grubbing</i>	Lump Sum

201.5.1 Work Included in Payment

The Department will consider the following Work as included in the payment for Clearing and Grubbing and no separate payment will be made:

1. Obtaining disposal locations and in making the disposal;
2. Material and Material placement and compaction to fill stump holes and other voids;
3. When clearing and grubbing is not established as a pay item;
4. Herbicide applied for noxious weed control; and
5. Delivery to storage site if required of salvageable timber.

Selective / Non-Selective Herbicide Application will be paid only if the Plans list this item in the Estimated Quantities table.

SECTION 203: EXCAVATION, BORROW, AND EMBANKMENT

203.1 DESCRIPTION

This Work consists of performing excavation in soil and rock Material, providing borrow Material, constructing Embankment, hauling, disposing, placing, and compacting Materials.

203.2 MATERIALS

The Department will provide geotechnical and/or pavement investigation data in the Contract documents, when available. The Contractor shall use the data for information only.

203.2.1 Material Classifications

203.2.1.1 Rock Excavation

Rock excavation is Material that meets one (1) of the following field test criteria:

1. **Ripping Test.** Material that cannot be broken down with two passes parallel to construction centerline with a single tooth ripper mounted on a crawler-type tractor in low gear with a minimum net flywheel power rating of 255 hp;
2. **Seismic Test.** Material that has a seismic velocity greater than 6,000 ft/s. The Contractor shall submit the qualifications of the individual performing and interpreting the seismic testing to Project Manager for approval a minimum of 14 Days prior to testing. Perform the Ripping Test to resolve differences in Material classification if seismic velocities fall below 6,000 ft/s; or
3. **Handling Test.** Boulders or detached stones having a volume greater than one (1) yd³ that cannot be readily broken down with excavation Equipment.

203.2.1.2 Unclassified Excavation

Unclassified excavation shall consist of the excavation of all Materials other than rock excavation obtained within the Right of Way. Suitable Material obtained from unclassified excavation shall be used for areas that require Embankment.

203.2.1.3 Borrow

Borrow shall consist of Contractor provided suitable Embankment Materials obtained from an approved source outside the Right of Way, unless otherwise specified in the Contract. The Contractor shall only utilize borrow when the following conditions are met, unless approved otherwise by the Project Manager:

1. All unclassified excavation Material has be utilized in the Contractor's current phase of construction;
2. The Contractor has requested to begin Borrow operations and the Project Manager has concurred; and
3. Embankment areas that require borrow have been bladed and cross sectioned by the Contractor and provided to the Project Manager.

Borrow Material placed within two (2) Ft, vertically and laterally, of final Subgrade elevations shall meet the design R-Value as shown in the Contract. Prior to borrow operations the Contractor shall perform R-value testing in accordance with AASHTO T-190 at the best fit exudation pressure of 300 psi at each borrow source. This information shall be submitted to the Project Manager with the request to begin borrow operations. During borrow placement, if the Project Manager observes changes in soil properties, including gradation, plasticity limits,

and/or additional soil characteristics, then, at the Project Manager's request, additional AASHTO T-190 tests may be required, at the Contractors expense.

When Work conforming to Section 306, "Portland Cement or Lime Treated Subgrade" is specified in the Contract, the Contractor shall perform sulfate testing in accordance with AASHTO T290 at each borrow source. Sulfate content shall be determined and reported as parts per million (ppm). Soils with sulfate contents equal to or greater than 2,000 ppm shall not be used as borrow.

203.2.1.4 Unstable Subgrade Stabilization

See Section 203A, "Unstable Subgrade Stabilization", when specified in the Contract.

203.2.1.5 Unsuitable Material

Unsuitable Material includes organic Materials, frozen lumps, ice, and soils such as peat, shale, gypsum or other soil or rock Materials that may degrade with time, or are contaminated. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material below embankment and areas identified by the Project Manager and determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with this Specification.

203.3 CONSTRUCTION REQUIREMENTS

203.3.1 General

The Contractor shall finish excavation and Embankment for the Roadway, intersections, and entrances to reasonably smooth and uniform surfaces. The Contractor shall not remove Materials from the Project limits without the approval of the Project Manager.

The Contractor shall ensure Borrow Material placed within the top two (2) Ft of the finished Subgrade meets the minimum design R-value.

The Contractor shall preserve the Materials below and beyond the lines and grades while conducting excavation operations. Before beginning excavation, grading, and Embankment operations, the Contractor shall perform the necessary clearing and grubbing in accordance with Section 201, "Clearing and Grubbing." The Contractor shall notify the Project Manager before opening excavation or borrow areas. The Contractor shall take cross section elevations of the ground surface before opening excavation or borrow areas.

The Contractor shall terminate operations in the immediate area of environmental or Cultural Resources not listed in the Contract, until the Department reviews and completes appropriate mitigation actions in accordance with Section 107.12, "Environmental, Hazardous Materials and Cultural Resource Discoveries."

203.3.2 Excavation

Within cut sections, the Contractor shall remove excavated Material from the limits of the cut section to the Subgrade elevation for the width of the Roadbed. The Contractor shall finish Roadbed cut sections to a smooth and uniform surface. The Contractor shall remove unsuitable Material below finished Subgrade in accordance with 203.2.1.5, "Unsuitable Material." The Contractor shall take cross-sectional measurements after the removal of unsuitable Material.

203.3.3 Rock Cuts

The Contractor shall perform proper drilling and blasting operations in accordance with the specified practices. When required, the Contractor shall perform controlled blasting of rock excavation to produce a clean face on the excavated cut. The Contractor shall ensure subsequent blasting and excavation operations do not affect previously excavated faces. The Contractor shall not excavate more than six (6) inches below the specified Subgrade elevation for Roadbed cuts in rock, unless directed otherwise. The Contractor shall not leave undrained pockets on the Roadbed surface. The Contractor shall place and compact Base Course on the rock cut foundation in accordance with Section 303, "Base Course."

203.3.3.1 Blasting Requirements

The Contractor shall use controlled blasting to establish a specified backslope with minimal blast damage, and production blasting to facilitate excavation. Before the start of blasting, the Contractor shall notify adjacent property owners, occupants and utility owners.

203.3.3.1.1 Definitions

Blasting Operations. Activities related to blasting including, but not limited to the following:

1. Collaring and drilling blast holes;
2. Preparing, fixing, loading, and firing explosive charges;
3. Assessing the blast after detonation; and
4. Handling misfires.

Buffer Row. The first row of production blast holes immediately adjacent and drilled in a plane parallel to the controlled blast line. The explosive load in the buffer row should be reduced from standard production loads to minimize damage to the backslope of the final excavation.

Controlled Blasting. The controlled use of explosives and blasting accessories in carefully spaced and aligned blast holes to provide a free surface or shear plane in the rock along the specified backslope, and to limit fly rock, permanent ground displacement, air concussion, and overbreak. Controlled blasting methods include pre-splitting and cushion blasting.

Cushion Blasting (Trim Blasting). The simultaneous detonation of one (1) line of blast holes along a specified excavation backslope after the main excavation is complete. This method is performed to trim the excavation to the final backslope.

Final Line (Controlled Blast Line). Refers to the row of controlled blast holes drilled in the plane of a specified excavation backslope. The controlled blast holes drilled in this plane constitute the basis for payment under the Controlled Blasting pay item. The Department considers the blast holes drilled in front of the final line blast holes to be production blast holes, which are Incidental to the Rock Excavation pay item.

Pre-Splitting. The simultaneous detonation of one (1) line of blast holes drilled along a specified excavation backslope before production blast holes are fired.

Production Blasting. Fragmentation blasting in the main excavation area.

203.3.3.1.2 Submittals

203.3.3.1.2.1 Blaster in Charge

The Contractor shall not begin drilling or blasting Work until the Project Manager approves of the Blaster in Charge. The Contractor shall submit the name and qualifications of the proposed Blaster in Charge to the Project Manager for approval at least 30 Days before the delivery of explosive Material to the Project. The Contractor shall provide the following information:

1. Proof of a license by the applicable State and/or local regulatory agencies to possess, transport, and use explosives; and
2. A list of, and references, for at least three (3) blasting Projects, of similar complexity, successfully completed within the previous five (5) years.

The Blaster in Charge must be on site during blasting operations.

203.3.3.1.2.2 Blasting Plans

The Contractor shall submit a General Blasting Plan to the Project Manager for each cut that requires blasting, at least two (2) weeks before the start of drilling and blasting operations on a specified cut. The Contractor shall provide the following information in the General Blasting Plan:

1. Description of the proposed blasting operation;
2. Preliminary design criteria for production and controlled blasting, including blast hole depths and patterns; and
3. Details regarding the proposed explosives and blasting accessories.

The Contractor shall submit a Detailed Blasting Plan at least 48 H before an individual blast. The Contractor shall provide the following information in the Detailed Blasting Plan:

1. Station limits of the proposed location of the blast, including the bench elevation, if applicable;
2. Date and time the blasting will occur;
3. Required removal of overburden, if applicable;
4. Plan and cross section diagrams of proposed drill pattern for controlled and production blast holes, including buffer rows, free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height, and subdrill depth. Draw these Plans and cross sections to scale;
5. Loading diagram showing the type and amount of explosives, primers, and initiators; and the location, depth, and type of stemming;
6. Initiation sequence of controlled and production blast holes, including Delay times and the Delay system; and
7. Manufacturer's data sheets for the explosives, primers, and initiators to be used.

The Contractor shall submit the blasting Plans to the Project Manager for review and Acceptance. The Project Manager will review and provide comments to the Contractor. The

Contractor shall submit revisions to the blasting Plans for final review and Acceptance. The Contractor shall not proceed with drilling and blasting operations related to a General Blasting Plan or loading of blast holes associated with a Detailed Blasting Plan without written notice.

The Contractor shall cease blasting operations and submit revised blasting Plans if the Department determines that the blasting operations are causing property damage in and beyond the Right of Way.

203.3.3.1.2.3 Blasting Records

The Contractor shall prepare and submit to the Department a Blasting Record for each blast, on the Day of the blast. The Contractor shall provide the following information in a Blasting Record:

1. Actual dimensions of the shot, including blast hole diameters and depths, burden, spacing, subdrilling depths, stemming, powder loads, powder factors, and timing;
2. A drawing or sketch showing the direction of the face and the physical shot layout;
3. The location of the blast in relation to Project stationing and elevation;
4. The date and time of loading and detonation;
5. The name and signature of the person responsible for loading and firing;
6. Comments by Blaster in Charge regarding misfires, fly rock occurrences, unusual results or effects; and damage to existing facilities, adjacent property, or completed Work;
7. Vibration and blast monitoring results; and
8. Any complaints received due to the blasting.

203.3.3.1.3 Explosives

The Contractor shall transport, store, handle, and use explosives in accordance with applicable federal, State, and local laws and regulations. The Contractor shall purchase explosives and accessory devices from industry recognized Suppliers and manufactures. The Contractor shall use explosives and accessory devices in accordance with manufacturer instructions. The Contractor shall not use expired products.

The CFR specifies responsibility for the following federal agencies regarding the administration of regulations involving explosive Materials:

1. Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). Storage and accountability of record keeping and security in accordance with 27 CFR part 555;
2. OSHA. Transportation, worker safety, and health in accordance with title 29 CFR; storage and safe blasting practices in handling and use in accordance with 29 CFR part 1926.900 et seq; and
3. Federal Department of Transportation (USDOT). Transportation and public safety, 49 CFR.

The fire marshal, sheriff, or other local officials, may have additional regulations for explosive Materials.

203.3.3.1.4 Safety

The Contractor shall follow safe practices, including the following:

1. Federal, State, and local regulations pertaining to the transportation, storage, and use of explosives must be strictly followed;

2. When required, the Blaster in Charge must obtain a blasting permit from the local regulatory agency before blasting;
3. Only persons authorized and qualified based on training and experience will handle and use explosives;
4. No person will smoke; carry matches or other flame producing devices; or carry firearms or loaded cartridges while in or near a motor vehicle that is transporting explosives;
5. Keep track of explosives at all times. Explosives must be stored and locked in an approved magazine facility in accordance with the applicable provisions of the Department, ATF, and OSHA until used in blasting;
6. Post appropriate signs in the required areas and vehicles in accordance with federal regulations;
7. Safely station the necessary guards or flag persons on Highways during blasting to control Highway traffic; and
8. Before starting Work in the cut, observe the entire blast area for at least five (5) minutes after each blast. Remove potentially dangerous rocks or other Material located beyond the excavation limits. Cease blasting operations if the required slopes are not stable, or if the safety and convenience of the public are being jeopardized.

203.3.3.1.5 Vibration Risk Survey

For each cut that requires blasting, the Contractor shall perform a vibration risk survey of nearby buildings, Structures, utilities, water supplies, or environmentally sensitive areas that may be at risk of blasting or construction damage. The Contractor shall perform the vibration risk survey in accordance with Section 617, "Vibration Monitoring and Video Taping." The Contractor shall obtain written approval for the vibration risk survey from the Project Manager before drilling blast holes.

203.3.3.1.6 Blasting Test Sections

The Contractor shall demonstrate the adequacy of proposed Blasting Plan with a blasting test section(s) for Material of different geologic characteristics. For Projects involving multiple cuts in similar geologic Materials, the Project Manager may reduce the requirement for a blasting test section in each cut. Blasting test sections include drilling, blasting, and excavating cut sections approximately 100 Ft long to determine the optimal combination of method, blast hole spacing, and charge. When field conditions warrant, the Project Manager may direct the Contractor to use test section lengths less than 100 Ft long.

Blasting test section requirements include the following:

1. The Contractor shall perform the blasting test section in accordance with Section 203.3.3.1, "Blasting Requirements." The Contractor shall prepare and submit a Detailed Blasting Plan for the test section to the Project Manager at least 48 H before the planned time of the blast. The Contractor shall not start blasting the test section until the Project Manager Accepts the Detailed Blasting Plan;
2. Unless the Contractor's Detailed Blasting Plan indicates otherwise, the Contractor shall begin the tests with the controlled blast holes spaced at 30 inches; and
3. After blasting, the Contractor shall remove a sufficient amount of Material from the test section to determine if the blast hole diameter, blast hole spacing, and amount of explosives are adequate to provide the required backslope. The Contractor shall not continue drilling of the test section area until the test section is excavated and the Department evaluates the results.

If, at any time during the progress of the main blasting operation, the methods of drilling and blasting do not produce the desired results, the Contractor shall revise and retest the blasting techniques until a technique produces the required results. The Department will consider the results to be unsatisfactory if:

1. There is an excessive amount of breakage beyond the indicated lines and grade;
2. There is excessive flyrock;
3. The final backslope within the specified tolerances is not uniform or overhangs are created;
4. Ground vibration and air blast levels exceed limits as stated in Section 617, "Vibration Monitoring and Video Taping;"
5. There are violations of other requirements of the Specifications;
6. The slopes are unstable;
7. The safety of the public is jeopardized; and
8. Property or natural features are endangered.

203.3.3.1.7 Blasting Execution

203.3.3.1.7.1 Notification and Schedule

The following requirements will apply to the notification and scheduling of blasting procedures:

1. The Contractor shall coordinate blasting operations with the Project Manager and notify the Project Manager a minimum of 1.5 H before the blast. The Contractor shall provide a one (1) hour timeframe for the blast. For example, if the Contractor notifies the Project Manager by 9:00 a.m. the blast may occur between 10:30 a.m. and 11:30 a.m.;
2. The Contractor shall provide notice to the required federal, State, and local agencies before each blast, as required by the blasting permits;
3. The Contractor shall notify occupants of buildings and owners of Structures and utilities of the blast time and location at least 48 H before the start of drilling or blasting; and
4. The Contractor shall detonate blasts at the planned time, unless approved otherwise by the Project Manager.

203.3.3.1.7.2 General Requirements

The Contractor shall cover the blast area with blasting mats, soil, or another equally serviceable Material, before firing blasts in areas where flying rock may result in personal injury or damage to property or the Work.

203.3.3.1.7.3 Controlled Blasting Requirements

The Contractor shall perform controlled blasting in accordance with the Detailed Blasting Plans that produced Acceptable results in blasting test sections. The Contractor shall perform control blasting using either pre-splitting or cushion blasting in accordance with the following requirements:

1. If the overburden does not support the drill holes, completely remove the overburden soil and loose rock along the top of the cut to expose the rock surface before drilling the controlled blast holes;

2. Mechanically monitor the blast hole angles;
3. Drill and space blast holes with a nominal diameter from two (2) inch to three (3) inch, in accordance with the blasting test sections or the results achieved in similar geologic Materials. Do not exceed three (3) Ft;
4. Use proper Equipment and technique to ensure that no blast holes deviate from the plane of the backslope shown in the Plans by more than eight (8) inches, parallel or normal to the slope. The Department will not pay for blast holes exceeding these limits unless the Project Manager approves the obtained slopes;
5. Drill the controlled blast holes at the required slope inclination, to the full depth of the cut, or to a pre-determined stage elevation. The maximum drill depth is 30 Ft. Use shallower holes if the directional control is inadequate. If more than five percent (5%) of the controlled blast holes are misaligned in any one (1) lift, reduce the height of the lifts until the eight (8) inch tolerance is met. The length of controlled blast holes may be incrementally increased once satisfactory directional control and blast results are demonstrated;
6. Drill unloaded and un-stemmed guide holes to the same diameter, in the same plane, and to the same tolerance as the controlled blast holes;
7. The Department will allow a maximum offset of 24 inches from the bottom of each lift to allow for drill Equipment clearances, when the cut requires more than one (1) lift. Begin drilling the control blast hole at a point that allows the necessary offsets, and adjust at the start of lower lifts as necessary to compensate for drift in the upper lifts;
8. Do not use horizontal blast holes for controlled blasting;
9. Use explosive charges, detonating cord, and other items necessary for the blasting operation in accordance with the manufacturer's recommendations and instructions;
10. Before placing charges, ensure the hole is free of obstructions. Use casing if necessary to prevent the walls of the hole from collapsing;
11. Use only standard explosives manufactured especially for the type of controlled blasting (cushion or pre-splitting). Do not load ammonium nitrate and fuel oil in the controlled blast holes. Use explosives and blasting accessories appropriate for the conditions of the blast hole (including water in the holes) and necessary to achieve satisfactory results;
12. Assemble and affix continuous column cartridge-type explosives to the detonating cord in accordance with the explosive manufacturer's instructions;
13. The bottom charge in a blast hole may be larger than the charges above, but not large enough to cause overbreak. Place the top charge far enough below the collar and sufficiently reduced in size to avoid overbreaking or heaving; and
14. Use a dry, angular, and granular Material that passes a 3/8 inch sieve to stem the controlled blast holes, from the top charge to the hole collar.

203.3.3.1.7.4 Pre-Split Blasting

The Contractor shall perform pre-split blasting in accordance with Section 203.3.3.1.7.3, "Controlled Blasting Requirements," and the following requirements:

1. Detonate the pre-split blast holes before drilling for production blasting; or fire the pre-split blast holes at least 75 Ms before the production holes if detonated in the same blast;
2. Fire pre-split blast holes simultaneously, unless ground vibrations, noise, or air blast are excessive. Fire pre-split holes in delayed sections and reduce the charge weight per delay to mitigate excessive effects;

3. The line of pre-split blast holes will extend beyond the limits of the production blast holes to be detonated. The minimum length of this extension will be 30 Ft or to the end of the cut, but will not be greater than one-half of the distance of the expected blast advance; and
4. Do not perform pre-split blasting if the distance between the controlled blast line and free face is less than 20 Ft or less than three (3) times the blast hole depth, whichever is greater.

203.3.3.1.7.5 Cushion Blasting

The Contractor shall perform cushion blasting in accordance with item No. 3 of Section 203.3.3.1.7.3, "Controlled Blasting Requirements," and the following requirements:

1. Perform cushion blasting as part of the final shot after other blasting is finished;
2. If the final shot includes production blast holes, detonate the cushion blast no more than 75 Ms or less than 25 Ms after the production blast; and
3. Fire cushion blast holes simultaneously, unless ground vibrations, noise, or air blast are excessive. Fire cushion blast holes in delayed sections and reduce the charge weight per delay to mitigate excessive effects.

203.3.3.1.7.6 Production Blasting

The Contractor shall perform production blasting in accordance with the Blasting Plan that produced Acceptable results in blasting test sections and the following requirements:

1. Minimize blast damage to the final excavation backslope;
2. Drill buffer rows of production blast holes on a plane approximately parallel to the controlled blast line;
3. Place the buffer row of production blast holes no closer than six (6) Ft to the controlled blast line unless the Contractor can prove the final excavation backslope will not be damaged by the production blast;
4. Where necessary to minimize damage to the excavation backslope, load blast holes in the buffer row lighter than other production holes;
5. Ensure the bottoms of production blast holes are not lower than the bottom of controlled blast holes, except in the lowest lift;
6. Ensure the diameter of production blast holes does not exceed six (6) inches, unless approved by the Project Manager;
7. Before placing charges, ensure the hole is free of obstructions. Use casing, if necessary, to prevent the walls of the hole from collapsing;
8. Use a dry, angular, and granular Material that passes a 3/8 inch sieve to stem the holes, from the top charge to the hole collar;
9. Detonate production blast holes in a controlled delay sequence toward a free face;
10. Do not use horizontal holes for production blasting, except for Equipment access; and
11. Use explosives and blasting accessories appropriate for wet or dry blast hole conditions as necessary to achieve satisfactory results.

203.3.3.1.7.7 Scaling and Stabilization of Slopes Established by Controlled Blasting

The Contractor shall perform scaling and stabilization of slopes established by controlled blasting in accordance with the following requirements:

1. Observe the entire blast area following a blast before starting Work in the cut. If any rocks are loose, hanging, or potentially dangerous within a blast area, the Contractor shall remove them. Scale slopes by hand using a standard steel mine scaling rod. Use other methods to supplement or in lieu of hand scaling, such as, machine scaling, hydraulic splitters, or light blasting, if approved by the Project Manager;
2. Slopes shall be scaled and stabilized before further construction activities take place. Scale slopes throughout the span of the Contract and as often as necessary to keep the slopes free of hazardous loose rock or overhangs; and
3. Cease blasting operations if the following conditions exist:
 - 3.1. There is an excessive amount of breakage beyond the specified lines and grade;
 - 3.2. There is excessive flyrock;
 - 3.3. The final backslope within the specified tolerances is not uniform;
 - 3.4. Ground vibration and air blast levels exceed limits specified in Section 617, "Vibration Monitoring and Video Taping;"
 - 3.5. There are violations of other requirements of the Specifications;
 - 3.6. The slopes are unstable;
 - 3.7. The safety of the public is jeopardized; and
 - 3.8. Property or natural features are endangered.

203.3.4 Borrow

The Contractor shall be responsible for obtaining the borrow source, unless otherwise specified in the Contract. The Contractor shall exhaust all available suitable Material from unclassified excavation operations prior to utilizing a borrow source. The Contractor shall notify the Project Manager in writing, and request that borrow operations commence, when the Contractor exhaust unclassified excavation Material for Embankment. Borrow placed prior to this notification shall not be paid. If the Contractor places more than the specified amount of borrow and causes a waste of unclassified excavation, the Department will deduct the wasted amount from the borrow volume, as measured in the borrow area. After unclassified excavation is complete, the Contractor shall blade the areas that require borrow to allow accurate payment measurements by cross sectioning by the Contractor. The Contractor shall maintain and restore Right of Way fencing removed for borrow operations to its original condition or better to prevent livestock from entering Right of Way during the Project.

203.3.5 Embankments

The Contractor shall not place Embankment Material on frozen earth, or incorporate frozen soils in Embankments. The Contractor shall suspend Embankment construction if Embankment Materials become frozen. The Contractor shall not resume until the Materials are thawed and suitable for compaction. Before beginning Embankment construction, the Contractor shall perform scalping in accordance with Section 201, "Clearing and Grubbing." The Contractor shall bench new Embankments into the following:

1. Natural slopes including rock;
2. Existing Embankments; or
3. Phased Embankment construction.

The Contractor shall ensure benches are wide enough to allow operation and placement of compacting Equipment. The Contractor shall recompact new Embankment Material and

Material that is cut out at no additional cost to the Department. The Contractor shall not place rock, broken concrete, or other solid Materials in Embankment areas where driven pilings, drilled shafts, utility lines, or other Structures are specified in the Contract.

203.3.5.1 Roadbed Embankments

The Contractor shall break up the original ground surface to at least six (6) inches by plowing, scarifying, or stepping up. The Contractor shall compact this area in accordance with Section 203.3.6, "Moisture and Density Control." The Contractor shall place Material for Roadbed Embankment in uniform lifts not exceeding eight (8) inches thick and compact in accordance with Section 203.3.6, "Moisture and Density Control."

The Department will allow rocks no larger than three (3) Ft (in any dimension) as long as the Contractor distributes and fills the interstices to form a dense mass. If the interstices between the rock fragments cannot be completely filled and compacted, the Contractor shall use bridging geotextile, approved by the Project Manager, over the top of the rock fragments to prevent the overlying Embankment Material from filling the interstices. The Contractor shall not use rock fragments that may degrade with time or may be water sensitive (such as shale or gypsum) as rock fill in Roadbed Embankments.

The Contractor may place larger rocks greater than three (3) Ft in any dimension in the toe of the slope in accordance with the following requirements:

1. No rock is larger than one-half the Embankment height or ten (10) Ft;
2. No rock is placed in fill height less than eight (8) Ft, measured at the edge of the Roadway Shoulder; and
3. Place rocks inside a line six (6) inches from the slope stake, space a minimum of three (3) Ft from edge to edge, and cover with approved Embankment Material.

The Contractor shall construct rock Embankments to a maximum of six (6) inches below Subgrade elevation. The Contractor shall consolidate rock fills by using the appropriate Equipment and methods approved by the Project Manager.

203.3.5.2 Non-Roadbed Embankment

The Contractor shall break up the original ground surface to at least six (6) inches by plowing, scarifying, or stepping up. The Contractor shall compact this area in accordance with Section 203.3.6, "Moisture and Density Control." The Contractor shall place Material for Non-Roadbed Embankment in uniform lifts not exceeding eight (8) inches thick and compact in accordance with Section 203.3.6, "Moisture and Density Control."

If the Embankment Material consists of rock, place the rock in layers of sufficient depth to contain the largest rock in the Material, and carefully distribute and fill the interstices to form a dense mass.

203.3.6 Moisture and Density Control

Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

The Contractor shall construct Roadbed, Roadbed Embankment, non-roadbed Embankment, and Roadway Median excavation or Embankment, with moisture and density control. The Contractor shall compact each layer of Embankment to at least 95% of maximum density as specified above. The Contractor shall ensure that the in-place moisture content of the soil shall not be less than five percent (5%) below optimum moisture content or greater

than two percent (2%) above optimum moisture content, at the time of compaction. For soils with a plasticity index of 15 or greater, the Contractor shall ensure the moisture content of the soil at the time of compaction is between optimum moisture to optimum moisture plus four percent (4%). If the moisture content at the time of compaction is not within the specified range, the Contractor shall moisten or dry the Material, then thoroughly mix the Material to the full lift depth before re-compacting. No additional payment shall be made for the reworking of Materials that do not fall within the ranges specified above.

Roadbed Embankments that contain mostly rock or coarse-grained Material (65% or greater retained on the No. 4 sieve) do not require moisture and density control, except the top six (6) inches of the Embankment; the Contractor shall construct in accordance with Section 207.3, "Construction Requirements." Non-roadbed Embankments of rock Material will not require moisture and density control unless otherwise specified in the Contract.

The Department will perform field densities in accordance with AASHTO T 310 or other Department approved methods. Densities shall be measured at each lift before the next subsequent lift is placed in accordance with Section 906, "Minimum Testing Requirements."

203.4 METHOD OF MEASUREMENT

203.4.1 Rock Excavation

The Department will measure Rock Excavation based on the estimated percentages if shown in the Contract, unless otherwise requested by the Contractor and approved by the Department.

If the Contractor requests, the Department will measure Rock Excavation in its original position for Material classified as Rock Excavation in accordance with Section 203.2.1.1, "Rock Excavation." Before excavation, the Contractor and Project Manager must agree on the limits of Material classified as rock excavation. The Contractor shall calculate volumes in accordance with Section 203.4.3, "Unclassified Excavation and Borrow." The Contractor shall include in measurements the overbreakage in rock excavation a maximum of ten (10) inches beyond the backslope specified in the Plans or as directed by the Project Manager. The Department will use the blaster's drill-hole log cards to determine the quantities of rock excavation covered by soil or overburden. The Contractor shall provide these log cards as part of the surveying records.

The Department will pay for stabilization necessitated by existing geological conditions and for Base Course and geotextile if necessary as required to backfill rock Subgrade conditions.

203.4.2 Controlled Blasting

The Department will measure Controlled Blasting by the blast holes drilled along the final line, whether loaded or not; and will measure the lengths from the top of the rock surface to the elevation of the Roadway ditch or to a bench elevation set by the Project Manager. The Department based the quantities for Controlled Blasting shown in the Plans on assumed blast hole spacing; the actual quantities depend on field conditions and the results from test sections.

203.4.3 Unclassified Excavation and Borrow

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure the original ground surface of all areas that are designated as unclassified excavation (cut sections) and/or Embankment (fill sections) using available

unclassified excavation Material), or Borrow (fill sections when all unclassified excavation Material has been exhausted). Prior to any Work continuing in completed excavation areas, the Contractor shall measure the newly excavated ground surface (final surface). For Embankment and borrow areas the Contractor shall measure the final surface once these operations are completed and Accepted by the Project Manager. Prior to commencing Borrow operations the Contractor must ensure that all requirements of Section 203.2.1.3, "Borrow" have been met. Earthwork quantities will be calculated as the neat volume from the original ground surface (less the existing Roadway surfacing) between the limits shown on the plans, and/or authorized changes by the Project Manager, and the new ground surface. The Department will not apply any shrinkage or swell factor due to payment being made on the final cross sectioned volume.

For the measurements described above the Contractor shall survey and submit the original ground surface and final surface data at completion of each phase of construction using an electronic XML- compatible format approved by the Project Manager. The Contractor shall use a New Mexico licensed Engineer or New Mexico licensed surveyor to stamp and certify cross-sections at 50 Ft intervals, unless otherwise specified in the Contract or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall submit certified volume summary reports to the Project Manager based on this electronic data for each phase of construction including a report that summarizes the basis for the final volumes.

203.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Rock Excavation</i>	Cubic Yard
<i>Unclassified Excavation</i>	Cubic Yard
<i>Borrow</i>	Cubic Yard
<i>Unsuitable Material Excavation</i>	Cubic Yard
<i>Controlled Blasting</i>	Linear Foot

203.5.1 Double Handling

The Department will pay for excavated Materials that require more than one (1) handling as identified within the Contract before final placement, including fertile topsoil required to be stockpiled and reserved for later use in the Work:

1. At the Bid Item Unit Price for unclassified excavation, for each handling approved by the Project Manager; or
2. As another item of Work for the second handling if specified in the Contract.

However, if the Contractor handles excavated and borrow Materials more than once, at the Contractor's request or at the convenience of the Contractor, there will be no additional cost to the Department. If the Contractor chooses to stockpile excess unclassified excavation Material to be used as borrow in a later phase, the Department will not pay for this Material as double handling. Double handling shall not be paid for Material that is excavated and placed in the same phase of the Project.

203.5.2 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 203.5, "Basis of Payment" and will not measure or pay for them separately:

1. Controlled blasting drill holes through overburden;
2. Production blasting;
3. Scaling within the limits of a final backslope established by controlled blasting;
4. Damage resulting from blasting;
5. Mobilization of any Equipment and testing of rock in accordance with Section 203.2.1.1, "Rock Excavation;"
6. Time Delays to perform testing of rock in accordance with Section 203.2.1.1, "Rock Excavation;"
7. Material required to fill the voids and irregularities in Embankment areas below the tolerance limit from the specified elevation;
8. Bridging geotextiles required to prevent overlying Embankment Material from migrating into the interstices between rock fragments;
9. Fence removal and replacement;
10. AASHTO T-190 Resistance R-Value and Expansion Pressure of Compacted Soils, including sampling, laboratory testing and reporting;
11. AASHTO T-290 Water-Soluble Sulfate Ion Content in Soil, including sampling, laboratory testing, and reporting;
12. Survey, calculations, and engineering;
13. Hauling and/or disposal related to Rock Excavation, Unclassified Excavation, Borrow, and Unsuitable Material Excavation; and
14. Suitable backfill Material for Unsuitable Material Excavation.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project Limits without written approval from the Project Manager.

SECTION 203-A: UNSTABLE SUBGRADE STABILIZATION

203-A.1 DESCRIPTION

This Work consists of stabilizing unstable Subgrade soils encountered in non-borrow sections such as cuts or existing grades within and not exceeding the top two (2) feet of finished subgrade elevation due to no fault or neglect of the Contractor. This Work includes costs associated with design/development of the Contractor's proposed stabilization option, Materials, labor, tools, Equipment, storage, laboratory and field testing, sampling, handling, excavation, disposal, removal, placement, hauling, processing with the Subgrade, shaping, compacting, surveying, finishing to grade, proof-rolling the Subgrade including all appurtenances, and Incidentals necessary to complete the Work.

Unstable Subgrade is defined as Subgrade that is saturated, soft, gummy, pumping, and/or displaces with applied loading.

Subgrade modified by this Specification is for stabilization only and is not considered in the structural design of the pavement structure; thus, no modification of the pavement structure shall be made.

203-A.2 MATERIALS

The Contractor shall use Materials included on the Department's current approved products list for its intended use or use Materials currently Accepted in the Contract.

203-A.3 CONSTRUCTION REQUIREMENTS

Where unstable Subgrade is due to the failure of the Contractor to maintain adequate surface drainage, or is damaged due to the operations or any other fault or neglect of the Contractor, the unstable condition shall be corrected at no expense to the Department.

Prior to Base Course placement over Subgrade or proposed stabilization option, the Contractor shall proof roll the Subgrade with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water truck filled to capacity. Areas lacking sufficient stability, as defined above, or as directed by the Project Manager shall be treated as unstable Subgrade.

Areas that exhibit displacement under lightly loaded Equipment may also be considered unstable by the Project Manager. For areas that become unstable prior to reaching Subgrade level (i.e., foundations, intermediate lifts, etc.), the Project Manager may designate these areas as unstable.

The Contractor shall choose any of the stabilization options listed below unless otherwise indicated in the Contract. If site conditions warrant a change in the stabilization method, it shall be at no additional cost to the Department. The Contractor shall submit options to the Project Manager for concurrence prior to stabilization.

1. Ripping, drying, and recompacting;
2. Excavation and replacement with Material that meets or exceeds the Project design R-value with laboratory tests performed in accordance with AASHTO T-190;
3. Use of Base Course, RAP, or select backfill;
4. Installation of underdrains and associated geotextiles and Material;
5. Geotextiles, geogrid base, and/or reinforcement Materials;
6. Blending of existing Materials with Materials approved by Project Manager; or

7. Combinations thereof.

The Project Manager may approve the use of excess Material obtained within the ROW that has previously been shown to be stable and workable. The Material associated with the listed options and the Work involved to obtain and place the Material shall be Incidental to the "unstable Subgrade stabilization" item and will not be paid separately. Areas disturbed within the ROW but not designated in the Contract shall be revegetated in accordance with Section 632, "Revegetation" at the Contractor's expense.

After stabilization and prior to placement of the base Material, the Contractor shall proof roll the stabilized Subgrade with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water tank filled to capacity and the Subgrade shall exhibit no displacement when proof rolled.

The Contractor shall make the necessary adjustments in the Equipment or operation so that underground utilities and permanent structures are not damaged.

The Contractor shall handle the processing of Material in such a manner that the dust or debris created by the operation will not be hazardous to the public or workers.

The Contractor shall construct stabilized Subgrade in such a manner that proper drainage is maintained.

When within the top six (6) inches of the Subgrade elevation, the stabilized Subgrade shall meet the grade and compaction requirements of SECTION 207, "SUBGRADE PREPARATION," or as approved by the Project Manager. Additional payment will not be made under Item Number 207000 – "Subgrade Preparation."

203-A.3.1 Equipment

Stabilization of unstable Subgrade shall be performed with a machine or combination of machines or Equipment that will produce a satisfactory product meeting the requirements for ripping, drying, recompaction, excavation, replacement, and blending of Materials as provided in these Specifications.

Single-shaft or multiple-shaft mixers are required for blending of existing Materials with Materials approved by Project Manager. Agricultural disks or motor graders are not Acceptable mixing Equipment unless Contractor can demonstrate thorough mixing and processing to the satisfaction of the Project Manager.

203-A.3.2 Acceptance

The stabilized Subgrade shall meet the requirements of SECTION 303, "BASE COURSE;" subsection 303.3.1, "Preparation of Subgrade." Prior to placement of the base Material, the stabilized Subgrade shall be proof rolled with either a pneumatic roller weighing a minimum of 25 tons or a 4000 gallon water tank filled to capacity and shall exhibit no displacement when proof rolled. Stabilized Subgrade locations that continue to exhibit displacement are to be corrected at no additional cost to the Department.

203-A.4 METHOD OF MEASUREMENT

Unstable Subgrade stabilization shall be measured from the Subgrade elevation as shown in the Contract, by the square yard regardless of depth up to two (2) feet.

203-A.5 BASIS OF PAYMENT

The Department will only pay for the Accepted quantities of unstable Subgrade stabilization in accordance with Section 203A.3.2, "Acceptance."

Pay Item	Pay Unit
<i>Unstable Subgrade Stabilization</i>	Square Yard

203-A.5.1 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 203-A.5, "Basis of Payment" and will not measure or pay for them separately:

1. Design/Development of Contractor proposed stabilization option(s);
2. All Materials required for stabilization;
3. Labor, tools, and Equipment;
4. Sampling and laboratory and field testing;
5. Handling, excavating, removing, disposing, hauling, and placement;
6. Processing Material with existing Subgrade;
7. Shaping, compacting, surveying, finishing to grade, proof-rolling, and all appurtenances and Incidentals necessary to complete the Work;
8. Subgrade Preparation; and
9. Revegetation of areas disturbed within the ROW, used to obtain Materials for stabilization.

SECTION 206: EXCAVATION AND BACKFILL FOR CULVERTS AND MINOR STRUCTURES

206.1 DESCRIPTION

This Work consists of excavating, placing and compacting select backfill, bedding, and flowable fill Materials, and disposing of Material related to construction of Minor Structures. Excavation includes dewatering, pumping, bailing, draining, sheeting, bracing, and Incidentals required for proper execution of the Work.

Ditches required at Culvert inlets and outlets, and other locations indicated in the Contract are included under the item for Unclassified Excavation.

206.2 MATERIALS

206.2.1 Select Backfill

The Contractor shall furnish a suitable, well-graded, compactible Material free of Recycled Asphalt Pavement (RAP), organic matter, clay balls, lumps, rock fragments that may degrade with time such as shale or gypsum and other Deleterious Materials. Select backfill Material shall conform to the following and be placed in accordance with the Contract:

1. For structures and pipes other than plastic pipe:
 - a. Maximum particle size: two (2) inch;
 - b. Soil classification, AASHTO M 145 A-1 or A-2-4;
2. For plastic pipe:
 - a. Maximum particle size: 1½ inch; and
 - b. Soil classification, AASHTO M 145 A-1 or A-2-4.

All Backfill Material shall meet the electrochemical criteria where specified in the Contract.

206.2.2 Flowable Fill

The Contractor may substitute flowable fill for select backfill in accordance with Section 516, "Flowable Fill," at no additional cost to the Department. The Contractor shall secure Culverts and minor Structures to prevent flotation.

206.2.3 Bedding

The Contractor shall furnish a suitable, well-graded, non-plastic, free draining Material, free of Recycled Asphalt Pavement (RAP), organic matter, clay balls, lumps, rock fragments that may degrade with time such as shale or gypsum and other Deleterious Materials. Bedding Material shall conform to the following and be placed in accordance with the Contract:

1. Maximum particle size: ½ inch or half the corrugation depth, whichever is smaller; and
2. Material passing No. 200 (75-µm) sieve: ten percent (10.0%) max AASHTO T 27 and AASHTO T 11.

All Bedding Material shall meet the electrochemical requirements where specified in the Contract.

206.2.4 Unsuitable Material

Unsuitable Material includes organic Materials, frozen lumps, ice; soils such as peat, shale, gypsum or other Materials that may degrade with time, or are contaminated soil. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material below minor Structures and areas identified by the Project Manager, determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with this Specification.

206.3 CONSTRUCTION REQUIREMENTS

206.3.1 General

The Contractor shall remove unsuitable foundation Material below the specified bottom-of-structure elevation and replace with approved Material, as directed by the Project Manager. The Contractor shall use backfill Material to backfill Culverts in accordance with Section 206.2.1, "Select Backfill," or Section 206.2.2, "Flowable Fill," unless otherwise shown on the Plans. The Contractor shall ensure the moisture content of the soil; at the time of compaction is not less than five percent (5%) below optimum moisture content or greater than optimum moisture content. The Contractor shall compact the top six (6) inches of existing ground to at least 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). The Contractor shall maintain the density, approved surface elevation, and shape of the foundation immediately before placing Structures and forms.

The Contractor shall distribute backfill Material in uniform layers, each no more than eight (8) inches thick (loose measurement) and compact to 95 percent (95%) maximum density. At the time of compaction, the Contractor shall ensure that the in-place moisture content of the soil is not less than three percent (3%) below optimum moisture content or greater than three percent (3%) above optimum moisture content in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). The Contractor shall test field density and moisture content using nuclear methods in accordance with AASHTO T 310 and Section 906 "Minimum Testing Requirements."

Application of load including backfill against new masonry or concrete Structures shall be in accordance with Section 511.3.5.6, "Sequence of Placement and Application of Load." The Contractor shall maintain Structure alignment and integrity during backfill compaction. The Contractor shall not place backfill on frozen earth or with frozen Materials. The Contractor shall suspend operations until Material is thawed and meets requirements of this Specification. The Contractor shall remove sheeting and bracing before placing backfill.

206.3.2 Pipe Culverts, Storm Drains, and Structural Plate Pipe

For preparation and installation of pipe culverts, storm drains, and structural plate pipes with bottoms the Contractor shall remove rock and other unyielding foundation Material a minimum of four (4) inches (maximum 12 inches) below the bottom of the Structure. The Contractor shall backfill this added depth with an approved Material as identified in the Contract. The Contractor shall excavate trenches as described in the Contract to allow for pipe joining and compaction of the bedding and backfill Material under and around the pipe in accordance with Section 206.3.1, "Construction Requirements, General." The Contractor shall

ensure that the trench width for pipes and Culverts conforms to the trench widths requirements in Section 570.3.2, "Excavation and Backfill." The Contractor shall uniformly compact the trench for its full length and width. If specified in the Contract, the Contractor shall provide the longitudinal camber of the specified magnitude for cross drains.

206.3.3 Box Culverts and Other Drainage Structures

For preparation and installation of box culverts and other drainage structures the Contractor shall excavate Material to the elevations established by the Contract. The Contractor shall not remove Material, except unsuitable Material, below the final grade, if placing footings on excavated surfaces other than rock. The Contractor shall remove rock and other unyielding foundation Material a maximum 12 inches below the bottom of the Structure. The Contractor shall clean rock seams and cavities, and fill with concrete or grout. If the Contractor's excavation extends beyond the neat lines shown in the Contract, the Contractor shall use concrete (of the same class as the footing) to backfill these areas, at no additional cost to the Department.

The Contractor shall notify the Project Manager after each footing excavation. The Contractor shall not place footings until the excavation depth and foundation Materials are approved by the Project Manager. The Contractor shall maintain the moisture and density and the approved surface elevation and shape of the foundation before installing reinforcing steel.

206.4 METHOD OF MEASUREMENT

The Project Manager will measure the void created by the removal of Unsuitable Material Excavation below the bottom-of-structure elevation.

206.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Unsuitable Material Excavation</i>	Cubic Yard

The Department will pay for rock excavation in accordance with Section 203, "Excavation, Borrow, and Embankment."

206.5.1 Work Included in Payment

Excavation, disposal of unsuitable Material, bedding, backfill and select backfill Materials, placement and compaction of bedding and select backfill Materials for Culverts, storm drains, other drainage Structures, box Culverts, and minor Structures shall be included in the Contract unit price per linear foot of Structure identified in the Contract.

Excavation shall include all dewatering, pumping, bailing, draining, sheeting, bracing, and Incidentals required for proper execution of the Work. Select backfill shall include the use of Section 516, "Flowable Fill." Backfilling with concrete of the same class as the footings where the Contractor excavates below the established final elevation for bottom of footings or beyond the neat lines of the footings in rock or other hard foundation Material shall be included in the Contract unit price per linear foot of Culvert. Unrippable rock or unyielding Material will be defined and paid for as covered in Section 203, "Excavation, Borrow, and Embankment."

SECTION 207: SUBGRADE PREPARATION

207.1 DESCRIPTION

This Work consists of compacting and finishing the Subgrade.

207.2 MATERIALS—Reserved

207.3 CONSTRUCTION REQUIREMENTS

Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

The Contractor shall ensure the top two (2) feet of borrow Materials in the finished Subgrade is comprised of Material with the design R-value.

The Contractor shall compact the top six (6) inches of the Roadbed to 95% of maximum density.

The Contractor shall ensure the soil moisture content (at the time of compaction) is from optimum to optimum minus five percent (5%). For soils with a PI of 15 or greater, the Contractor shall ensure the moisture content of the soil at the time of compaction is from optimum moisture to optimum moisture plus four percent (4%).

Field density tests shall be performed in accordance with AASHTO T310 or by other Department approved methods and Section 906, "Minimum Testing Requirements."

207.3.1 Tolerances

The Contractor shall ensure the top surface of the finished Subgrade along centerline shall not vary by more than 0.1 foot above or below established grade and 0.05 foot above or below the typical cross-section measured on the finished surface at right angles to the centerline. The Contractor shall correct all deviations from these tolerances.

207.4 METHOD OF MEASUREMENT

The Department will measure Subgrade preparation using the dimensions shown in the Contract and/or approved modifications.

207.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Subgrade Preparation</i>	Square Yard

207.5.1 Work Included in Payment

The Department will consider the item(s) listed in this section as included in the pay items(s) listed in Section 207.5, "Basis of Payment" and will not measure or pay for them separately:

1. No payment will be made for rehandling or reworking Material to meet moisture and density requirements; and
2. Proof rolling for Unstable Subgrade Stabilization shall be considered Incidental to the Contract and will not be measured or paid for separately.

SECTION 209: BLADING AND RESHAPING

209.1 DESCRIPTION

This Work consists of constructing or restoring and shaping Roadbeds and Base Course to the typical section or as specified in the Contract.

209.2 MATERIALS—Reserved

209.3 CONSTRUCTION REQUIREMENTS

The Contractor shall shape the surface of the Roadbed or Base Course Materials to the typical section or as specified in the Contract with approved existing Materials. The Contractor shall replace any unapproved existing Roadbed or Base Course Materials in accordance with the requirements of Section 203, "Excavation, Borrow, and Embankment" and Section 303, "Base Course", as directed by the Project Manager.

209.3.1 Compaction

The Contractor shall perform the following to the top six (6) inches of the Roadbed or Base Course, after restoring the grade and typical section:

1. Scarify;
2. Water to ensure the moisture content of the Roadbed and Base Course Materials meet the requirements of Section 203, "Excavation, Borrow and Embankment;" and Section 303, "Base Course;"
3. Compact to 95% of maximum density per AASHTO T180 Method A or D (TTCP Modified); and,
4. Frequency of testing shall be performed in accordance with Section 906, "Minimum Testing Requirements."

209.3.2 Tolerances

The Contractor shall ensure the top surface of the finished Roadbed or Base Course Materials along centerline shall not vary by more than 0.1 foot above or below established grade and 0.05 foot above or below the typical cross-section measured on the finished surface at right angles to the centerline. The Contractor shall correct all deviations from these tolerances.

209.4 METHOD OF MEASUREMENT

The Department will measure blading and reshaping along the Roadbed centerline or the typical section.

209.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Blading and Reshaping</i>	Mile

209.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Restoring Grade and typical section;

2. Material placement and compaction;
3. Reworking or rehandeling Materials to meet compaction requirements; and
4. Finishing Roadbed or Base Course to uniform grade and typical section.

SECTION 210: EXCAVATION AND BACKFILL FOR MAJOR STRUCTURES

210.1 DESCRIPTION

This Work consists of excavating, disposing of Material, supplying and placing backfill Material related to the construction of Bridges, cast-in-place retaining walls, and CBC's 20 feet or greater measured along the centerline of the Roadway. Excavation and backfill for Major Structures includes dewatering, temporary shoring and bracing and other Incidentals required for proper execution of the Work.

210.2 MATERIALS

210.2.1 Select Backfill

The Contractor shall use Base Course per Section 303 "Base Course", A-1 or A-2-4 Material as determined by AASHTO M145 composed of stone, crushed stone, crushed or screened gravel, caliche, sand, or a combination thereof, unless otherwise specified in the Contract. The Contractor shall use Material that is free of Deleterious Materials, peat, gypsum, shale or other Materials that may degrade with time or are contaminated. Material shall not contain lumps or stones with an average dimension greater than two (2) inches.

The Contractor shall not use Recycled Asphalt Pavement (RAP) as select backfill Materials. The Contractor shall not use Base Course containing RAP for use as select backfill Materials.

210.2.2 Approach Slab

The Contractor shall use AASHTO Soil Classifications A-1-a Material with a maximum coarse fraction size of 1.5 inches or Base Course per Section 303, "Base Course" under the approach slab. The Contractor shall extend the Material to a minimum of ten (10) feet beyond the end of the approach, unless otherwise specified in the Contract, for the full width of the abutment and to the depth indicated in the Contract. Recycled Asphalt Material (RAP) shall not be used within this prism.

210.2.3 Unsuitable Material

Unsuitable Material includes organic Materials, frozen lumps, ice, and soil/rock such as peat, shale, gypsum or other Materials that may degrade with time, or are contaminated. Suitable Material that is unstable may be reworked to create a stable platform as directed by the Project Manager.

Material identified by the Project Manager and determined to be unsuitable shall be excavated and disposed of in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract.

When unsuitable Material is removed and disposed of, the resulting void shall be filled with Material suitable for its planned use as directed by the Project Manager. Such suitable Material shall be placed and compacted in accordance with Section 210.3.2, "Compaction."

210.3 CONSTRUCTION REQUIREMENTS

210.3.1 General

The Contractor shall excavate Material to the elevations established in the Contract. The Contractor shall not remove Material, except unsuitable Material, below the final grade, if

placing footings on excavated surfaces other than rock. The Contractor shall remove rock and other unyielding foundation Material a maximum of 12 inches below the bottom of the Structure. The Contractor shall clean rock seams and cavities, and fill with concrete or grout. This additional concrete or grout is Extra Work. The Contractor shall notify the Project Manager after each footing excavation. The Contractor shall not place footings until the Project Manager approves the excavation depth and the foundation Material.

The Contractor shall dewater wet pits for inspection and for construction of footings. When necessary, the Contractor shall install well-braced cofferdams, built as watertight as practical. The Contractor shall not use timber or bracing inside cofferdams that cannot be removed without damage to the concrete. The Contractor shall make temporary Structures large enough to provide ample room for pile driving, drilled shaft construction, form construction, inspection, and sump pumps. The Contractor shall straighten or move cofferdams that threaten to damage the Structure. The Contractor shall submit to the Project Manager Working Drawings showing proposed methods of constructing cofferdams, cribs, shoring, or similar temporary Structures sealed by a New Mexico licensed Engineer. The submittal of Working Drawings does not relieve the Contractor of any responsibility.

The Contractor shall backfill excavated areas not occupied by piles, shafts, abutments, or other permanent Structures to the adjoining finished surface elevation. The Contractor shall not use rock in backfill that is within two (2) ft of the Structure. The Contractor shall place backfill Material in approximately level layers for the length and width of the backfilled area. When necessary to prevent wedge action, the Contractor shall bench the slopes bounding the area being backfilled in accordance with Section 203.3.5.1, "Roadbed Embankments." The Contractor shall dispose of unsuitable excavated Material outside of the Roadway Prism as directed by the Project Manager. Before placing backfill Material against new masonry or concrete Structures, the Contractor shall wait until the concrete has developed its specified design strength as determined in Section 510.3.5.1, "Concrete Strength" or until the concrete reaches 80% of the specified compressive strength but no less than 2,500 psi, as determined by the Maturity Method, in accordance with Section 510.3.5.2, "In-place Concrete Strength Measurements."

The Contractor shall prevent unbalanced loading while placing and compacting backfill Material.

210.3.2 Compaction

The Contractor shall place layers of uncompacted backfill no more than eight (8) inches thick. Before placing the next layer, the Contractor shall compact the Material to 95% of the maximum density near optimum moisture content as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified). Test for field density and moisture content using nuclear methods in accordance with AASHTO T 310 and Section 906, "Minimum Testing Requirements."

Prior to concrete placement the foundation soils shall be compacted to at least 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified).

210.4 METHOD OF MEASUREMENT

210.4.1 Major Structure Excavation

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure the original ground surface of any areas that are designated as Structure Excavation. Prior to any Work continuing in completed excavation areas, the

Contractor shall measure the newly excavated ground surface "final surface." Major Structure excavation quantities shall be measured and calculated as the neat volume below the original ground surface between the limits shown in the Contract, and/or approved changes by the Project Manager, and the final excavated ground surface.

For the measurements described above, the Contractor shall survey and submit the original ground surface and final excavated ground surface data at completion of each phase of construction or completed Major Structure using an electronic XML- compatible format approved by the Project Manager with a volume summary report summarizing the basis for the final volumes. If no cross section intervals are shown in the Plans, the Contractor shall propose cross-section intervals, to the Project Manager, that adequately quantify the volumes. The approved intervals shall be used for the entire Project unless otherwise specified in the Contract and/or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall use a New Mexico licensed Engineer or New Mexico licensed surveyor to stamp and certify the surveyed cross-sections and the volume summary report.

The Contractor shall not include the following volumes in structure excavation:

1. Material excavated outside vertical planes located 18 inches outside and parallel to the limits of the footings or foundations;
2. Excavation required because of slides, cave-ins, silting or filling due to lack of support of sides, the action of the elements or carelessness of the Contractor;
3. Any Material included within the staked limits of the surfacing and unclassified excavation for which measurement is covered under other sections;
4. Water or other liquid Material;
5. Material excavated before measurements of the original ground or embankment placement;
6. Material rehandled, except when the contract specifically requires excavation after Embankment placement; and
7. Rock encountered during structural excavation will be paid per Section 203.4.1, "Rock Excavation."

210.4.2 Major Structure Backfill

For each phase of the Project, identified in the Contract or approved by the Department, the Contractor shall measure major structure backfill by the cubic yard compacted in place in accordance with the limits shown in the Contract. The Contractor shall calculate major Structure backfill as the neat volume above the existing or excavated ground surface between the limits shown on the Plans, and/or authorized changes by the Project Manager, and the final compacted ground surface. The Department will not apply any shrinkage or swell factors due to payment being made on the final cross sectioned volume.

For the measurements described above the Contractor shall survey and submit the existing or excavated ground surface and final compacted ground surface data at completion of each phase of construction or completed major Structure using an electronic XML-compatible format approved by the Project Manager with a volume summary report summarizing the basis for the final volumes. If no cross section intervals are shown in the Plans, the Contractor shall propose cross-section intervals, to the Project Manager, that adequately quantify the volumes. The approved intervals shall be used for the entire Project unless otherwise specified in the Contract and/or approved by the Project Manager prior to commencement of earthwork operations. The Contractor shall use a New Mexico licensed

Engineer or New Mexico licensed surveyor to stamp and certify the surveyed cross-sections and the volume summary report.

No measurement for payment will be made of backfill required because of slides, cave-ins, silting or filling due to lack of support of sides, over excavation or any other action of the elements or carelessness of the Contractor.

210.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Major Structure Excavation</i>	Cubic Yard
<i>Major Structure Backfill</i>	Cubic Yard
<i>Unsuitable Material Excavation</i>	Cubic Yard

210.5.1 Work Included in Payment

Payment will be full compensation for the Work and Materials prescribed in this Section.

Excavation and Backfill for Major Structures includes the following:

1. Material compaction to 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method A or D (TTCP Modified);
2. All temporary shoring and bracing;
3. Dewatering;
4. Suitable backfill Material for Unsuitable Material Excavation;
5. Hauling and disposal of Material related to Structure Excavation and Unsuitable Material Excavation; and
6. Survey, calculations, and engineering.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project limits without written approval from the Project Manager.

SECTION 213: OBLITERATING OLD ROAD

213.1 DESCRIPTION

This Work consists of obliterating old Road.

213.2 MATERIALS—Reserved

213.3 CONSTRUCTION REQUIREMENTS

After the old Road is no longer needed for traffic, the Contractor shall remove and stockpile existing surfacing Materials to Subgrade in an environmentally Acceptable manner.

The Contractor shall fill ditches, rough grade the Road (to blend with the surrounding terrain) and form natural rounded slopes (approved by the Project Manager). Next, the Contractor shall scarify or plow (to thoroughly mix the remaining surfacing Material with earth), harrow, and smooth the Roadbed.

213.4 METHOD OF MEASUREMENT

The Department will measure obliterating old road along the centerline of the old Road.

213.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Obliterating Old Road</i>	Mile

213.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Removing, hauling, and stockpiling existing surfacing Materials; and
2. Grading, scarifying, and plowing.

DIVISION 300 – BASES

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SECTION 302: PROCESSING, PLACING, AND COMPACTING EXISTING PAVEMENT

302.1 DESCRIPTION

This Work consists of processing, placing, and compacting existing pavements.

302.2 MATERIALS

The following gradation requirements apply:

**Table 302.2:1
Gradation Requirements**

Sieve size (inch)	% passing
2	95-100
1 1/2	90-100

302.3 CONSTRUCTION REQUIREMENTS

The Contractor shall:

1. Process the existing pavement in place to a homogeneous mixture and a depth in accordance with the Plans.
2. Mix the existing pavement and underlying aggregate to a homogeneous mixture and a depth in accordance with the Plans.
3. Compact existing processed material to at least 96% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Department will take field density tests and gradation samples at random locations.

The Department will use nuclear testing methods to determine in-place densities in accordance with AASHTO T 310 and TTCP procedures for wet density moisture correction.

302.3.1 Surface Tolerance

The Department will allow a surface tolerance of 1/2 inch within ten (10) feet.

302.3.2 Sampling and Testing

The Department shall sample and test the existing processed material in accordance with the Department's "Minimum Testing Requirements" for Processing, Placing and Compacting Existing Pavement "Section 302."

302.4 METHOD OF MEASUREMENT

The Department will measure Processing, Placing, and Compacting Existing Pavement using the dimensions shown in the Contract or approved modifications.

302.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Processing, Placing, and Compacting Existing Pavement</i>	Square Yard

302.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this

section and will not measure or pay separately for the following Work:

1. All labor, materials, equipment and any other incidentals will be included in this pay item.

SECTION 303: BASE COURSE

303.1 DESCRIPTION

This Work consists of providing, hauling, and placing Base Course.

303.1.1 Stockpiling

This Work consists of providing, hauling, and stockpiling Base Course at specified locations.

303.1.2 Removing, Processing, and Placing Base Course

This Work consists of removing, hauling, processing, placing existing Base Course Material.

303.2 MATERIALS

303.2.1 General

Base Course consists of one (1) or more of the following:

1. Crushed stone;
2. Crushed or screened gravel;
3. Caliche;
4. Sand;
5. Recycled Asphalt Pavement (RAP) not to exceed 50%; recycled concrete pavement (RC) not to exceed 75%; and the combined RAP and RC not to exceed 75% by weight;
6. Processed glass aggregate.

Base Course shall not contain organic matter or other Deleterious Materials, including silt and clay balls.

The Department will allow a maximum of ten percent (10%) (by weight) processed glass aggregate, uniformly distributed, in composite Base Course. Processed glass aggregate shall meet physical properties and deleterious substance requirements in accordance with AASHTO M 318.

303.2.2 Aggregate Acceptance

The Department will accept Base Course based on random samples taken by the Department from the Roadway. Unless the Contract specifies otherwise, the Contractor shall produce Material in compliance with Table 303.2.2:1, "Type I Base Course Gradation Band" or Table 303.2.2:2, "Type II Base Course Gradation Band" as specified in the Contract and Table 303.2.2:3, "Base Course Physical Properties."

**Table 303.2.2:1
Type I Base Course Gradation Band**

Sieve size	% passing
1.0 inch	100
¾ inch	80--100
No. 4	30-60

**Table 303.2.2:1
Type I Base Course Gradation Band**

Sieve size	% passing
No. 10	20-45
No. 200	3.0-10.0

**Table 303.2.2:2
Type II Base Course Gradation Band**

Sieve size	% passing
1.0 inch	100
¾ inch	85-95
No. 4	40-70
No. 10	30-55
No. 200	6.0-15.0

**Table 303.2.2:3
Base Course Physical Properties**

Property	Specification Limit
Fractured Face ^a	Minimum 50% on Untreated Material
AI ^b	Maximum 35
LL	Maximum 25
PI	Maximum 6

^aMaterials retained on or above the No. 4 sieve shall have at least two (2) Fractured Faces when evaluated in accordance with AASHTO T-335, "Determining the Percentage of Fractured Faces in Coarse Aggregate."

^bMaximum AI of 35 for untreated natural aggregate source when calculated in accordance with Section 910, "AGGREGATE INDEX".

303.3 CONSTRUCTION REQUIREMENTS

303.3.1 Subgrade

The Contractor shall place base course on subgrade prepared in accordance with Section 207, "Subgrade Preparation."

303.3.2 Mixing and Placing

The Contractor shall:

- Place maximum six (6) inch (compacted) lifts, unless specified otherwise.
- Not Place Base Course Material on frozen Subgrade.
- Compact Base Course to at least 96% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

The Department will use nuclear testing methods to determine in-place densities in accordance with AASHTO T 310 and TTCP procedures for wet density moisture correction.

303.3.3 Surface Tolerance

The surface tolerance shall not exceed ½ inch within ten (10) feet as verified by the Department. All deviations greater than ½ inch shall be corrected by the Contractor and reverified by the Department.

303.3.4 Plan Base Course and Sub-base Depths

The Department will monitor and record Base Course depth during the placement in accordance with the Department's "Minimum Testing Requirements." If the placed thickness deviates from the requirements by more than minus ½ inch, the Contractor shall add Material and reprocess to correct the deficiency.

303.3.5 Stockpiled Base Course

The Contractor shall stockpile base course material at locations shown on the Plans and prevent segregation of Materials at each stockpile. The Contractor shall maintain each stockpile in accordance with the following requirements:

1. Place stockpiles upon prepared sites;
2. Make stockpiles neat and regular to prevent segregation;
3. Provide enough storage space for each size of aggregate;
4. Prevent contamination (store stockpiles away from vehicular and Equipment traffic);
5. Keep the storage site neat and orderly and keep the stockpiles accessible for sampling; and
6. Acceptance by the Department will be at the final stockpile location.

303.3.6 Removing and Processing Existing Base Course

The Contractor shall:

1. Minimize contamination of Base Course Material when removing it from the Roadway for reuse, and;
2. Meet the requirements as indicated in Section 303.3.2 "Mixing and Placing."

303.3.7 Sampling and Testing

The Contractor and Department shall sample and test the Base Course in accordance with Section 906 "Minimum Testing Requirements" for Base Course. Department personnel may test locations other than the random locations generated for statistical analysis. These tests will not be used for pay factor determination, but may be used to determine Acceptance or rejection of localized Material.

303.3.7.1 Contractor Quality Control

The Contractor shall develop and administer a Quality Control plan that ensures the product meets the requirements of Section 902, "Quality Control." The Contractor shall ensure that the Quality Control plan addresses the following elements:

1. Contractor management and process control personnel,
2. Testing Equipment and lab facilities,
3. Aggregate production,
4. Aggregate quality,
5. Stockpile management,

6. Proportioning,
7. Mixing and processing,
8. Transporting,
9. Placing and spreading,
10. Compaction,
11. Line and grade control, and
12. Criteria for the correction or rejection of unsatisfactory Materials.

The Contractor shall:

1. Provide copies of TTCP wallet cards or certifications for personnel who are responsible for sampling and testing the Base Course.
2. Update the list as required if personnel substitutions are made.
3. Use test results, inspections, and other Quality Control practices to assure the quality of each material source and to control processes for crushing, mixing, proportioning, processing, transporting, placing, spreading, and compacting quality.

303.3.8 Acceptance

The Department will accept Base Course Materials based on samples taken in accordance with the Section 906, "Minimum Testing Requirements" after placement but before compaction. Acceptance will be in accordance with Section 303.2.2, "Aggregate Acceptance" and Section 303.3, "Construction Requirements. If necessary, the Contractor shall re-work the Base Course until all requirements are met at no additional expense to the Department.

303.4 METHOD OF MEASUREMENT

When calculating the square yardage the Department will use the average Base Course width and the station-to-station length along the centerline. The dimensions will show on the typical section of the Plans. When calculating the weight of the material, the Department will deduct the weight of moisture that exceeds the optimum moisture content plus two percent (2%). No additional payment shall be made for the stockpile pad.

303.5 BASIS OF PAYMENT

The Department will pay for the accepted quantities of *Base Course* as determined in Section 303.3.8, "Acceptance."

Pay Item	Pay Unit
<i>Base Course</i>	Cubic Yard or Ton
<i>Base Course _____inch Depth</i>	Square Yard
<i>Remove, Process and Place Base Course</i>	Square Yard or Ton
<i>Stockpiled Base Course</i>	Cubic Yard or Ton

303.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Providing, hauling, placing, and compacting Base Course Material;
2. Stockpiling, if required by contract;

3. Quality Control in accordance with Section 902, "Quality Control;" and
4. Remove, process, and place Base Course, if required by contract.

SECTION 306: PORTLAND CEMENT OR LIME TREATED SUBGRADE

306.1 DESCRIPTION

This Work consists of the following:

1. Preparing the Roadbed;
2. Providing, applying, mixing, and processing Portland Cement or Lime; and
3. Compacting the mixture.

306.2 MATERIALS

306.2.1 Portland Cement Treated Subgrade

The Contractor shall provide Portland cement in accordance with Section 509, "Portland Cement Concrete Mix Designs" or Section 510, "Portland Cement Concrete."

306.2.2 Lime Treated Subgrade

306.2.2.1 Hydrated Lime

The Contractor shall provide hydrated lime in accordance with AASHTO M 216. When dry sieved in a mechanical shaker for ten (10) min \pm 30 s, a 0.5 lb test sample of hydrated lime shall conform to the gradation requirement in Table 306.2.2.1:1, "Hydrated Lime Gradation Requirements."

**Table 306.2.2.1:1
Hydrated Lime Gradation Requirements**

Sieve size	% passing
No. 30	97.0 – 100.0
No. 200	75.0 – 97.0

306.2.2.2 Quicklime

The Contractor shall provide quicklime in accordance with AASHTO M 216. When dry sieved in a mechanical shaker for ten (10) min, \pm 30 s, ensure a 0.5 lb test sample of quicklime is in accordance with Table 306.2.2.2:1, "Quicklime Gradation Requirements."

**Table 306.2.2.2:1
Quicklime Gradation Requirements**

Sieve size	% passing
3/4 inch	95 – 100
No. 100	0 – 25

306.2.2.3 Lime-Slurry

The Contractor shall provide lime-slurry as a suspension of solids in water that can be pumped. The water or liquid portion of the slurry is free of dissolved material. Lime-slurry shall be a mixture of quicklime and water. The hydrated lime solids in the mixture shall meet the following requirements:

1. **Chemical Composition.** Lime-slurry with a "solids content" of at least 90% (by weight) calcium and magnesium oxides;
2. **Residue.** Lime-slurry mixture with a retained "solids content" residue in

accordance with Table 306.2.2.3:1, "Lime Slurry 'Solids Content' Gradation Requirements;" and

**Table 306.2.2.3:1
Lime-Slurry "Solids Content" Gradation Requirements**

Sieve size	% passing
No. 4	99 – 100
No. 30	96 – 99

3. **Grade.** Provide lime-slurry with a minimum "dry solids content," of 35%.

306.3 CONSTRUCTION REQUIREMENTS

306.3.1 Subgrade Preparation

The Contractor shall treat the Subgrade with either Portland cement or hydrated lime; quicklime, or lime-slurry in accordance with the State Materials Bureau's mix design.

The Contractor shall identify and correct soft areas, then shape the subgrade to the grades shown in the plans before adding Portland cement or hydrated lime, quicklime, or lime-slurry. The Contractor shall ensure that the scarified depth of the treated Subgrade (shown in the Plans) is free of Deleterious Material and stones retained on a three (3.0) inch sieve.

The Contractor shall:

1. Not perform Work during wet or inclement weather.
2. Mix and place the Portland cement-treated or lime-treated Subgrade, only if when the air temperature is at least 40 °F and rising in the shade.
3. Not mix or place cement-treated or lime-treated Subgrade on frozen Subgrade. When the air temperature is forecast to fall below 32 °F within a 48-hour period, the Contractor shall cease Work or ensure the Subgrade temperature will not fall below 40 °F.
4. Proof-roll the Material with Equipment, approved by the Project Manager, to expose and correct the soft areas.

Where unstable Subgrade is encountered in cuts or existing grades, due to no fault or neglect of the Contractor, sub-excavation and borrow will be paid for and measured as per Section 203, "Excavation, Borrow, and Embankment." Engineered designs will be measured and paid for on an item by item basis or as specified in the Contract. The Contractor shall conduct operations in such a way that the Project Manager can take the necessary cross-sectional measurements before the backfill is placed.

306.3.2 Portland Cement Treated Subgrade

Prior to the addition of Portland cement, the Contractor shall pulverize the Subgrade to the specified depth so that at least 80% (by weight) passes through a No. 4 sieve.

The Contractor shall:

1. Apply Portland cement at the specified application rate and to the depth shown on the Plans or as indicated on the State Materials approved mix design.
2. Ensure that cement dust is not a hazard to the public or workers when processing the Portland cement-treated Subgrade.

3. Perform mixing, placing, compacting, and finishing on the same day as the cement placement.

306.3.2.1 Mixing

The Contractor shall mix the portland cement, soil, and water with a self-propelled rotary-type mixing machine (approved by the Project Manager) to provide a uniform mixture. Overlap at least six (6) inches between passes.

The Department will consider streaks and pockets of portland cement as evidence of unacceptable mixing.

The Contractor shall ensure the Material moisture content ranges between optimum to five percent (5%) over optimum within the entire treated depth.

306.3.2.2 Finishing Operations

The Contractor shall:

1. Compact to 95% maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), immediately after mixing is complete.
2. Finish to ± 0.1 ft along centerline and ± 0.05 ft at right angles to the centerline.
3. Correct deviations from these tolerances.
4. Final roll the surface to finish the completed Work and prevent hairline cracking.
5. Finish within four (4) h of adding the Portland cement.

The Contractor shall allow the cement-treated Subgrade to cure for at least seven (7) Days before placing Base Course or Subbase Material on top of the cement-treated Subgrade or as approved by the Project Manager. Maintain a moist, not saturated, condition during the entire curing period, to prevent drying. If permitted by local jurisdiction, the Contractor may use an alternate curing procedure by applying a CSS-1 or SS-1 emulsified asphalt to the surface so that the surface is fully covered and sealed, as approved by the Project Manager.

306.3.3 Lime Treated Subgrade

The Contractor shall:

1. Use a distributor that will apply a uniform application and automatically adjust the spread rate for variable travel speeds.
2. Apply hydrated lime or quicklime dry, within $\pm 0.5\%$ of the specified percentage, by weight shown on the Plans or as indicated on the State Materials approved mix design, onto the prepared scarified Subgrade.
3. Not use a tailgate spreader. When used, the Contractor shall apply quicklime at the equivalent percentage to hydrated lime (one (1.0) ton quicklime is equivalent to 1.3 tons hydrated lime).
4. Apply lime-slurry, at the specified percentage of dry solids content onto the prepared scarified Subgrade, with a distributor having a pump and a spray bar.
5. Continuously circulate the slurry in transit and during application. The Contractor shall apply the lime-slurry within 24 h of its production. After 24 h, the slurry is considered expired.
6. Dispose of the expired slurry in an environmentally-acceptable manner, and shall not use it on the Project.
7. Replace lime-slurry that is left exposed on the ground to the open air for more than

ten (10) hours and shows excessive moisture loss.

306.3.3.1 Initial Mixing

The Contractor shall:

1. Process the hydrated lime, quicklime, or lime-slurry so as not to present a hazard to the public or workers.
2. Mix the Material immediately after applying the lime treatment using a self-propelled rotary-type mixing machine.
3. Provide a loose uniform mixture, with clods and lumps no larger than two (2) inch, that, when compacted, will meet the required depth and width shown in the Plans. The Contractor shall overlap at least six (6) inches between passes.

The Department will consider visible streaks and pockets as evidence of unacceptable mixing.

Immediately following mixing, the Contractor shall ensure the entire treated Subgrade depth's moisture content is three percent (3%) to five percent (5%) above optimum in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). Lightly compact the surface to minimize water loss or gain and lime carbonation.

306.3.3.2 Curing

The Contractor shall allow the treated lightly compacted Subgrade to cure for at least 24 h. Apply a seal during the cure period using either:

1. A water curing seal that maintains moisture content at not less than three percent (3%), or more than five percent (5%) above optimum as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified); or
2. An SS or CSS emulsified asphalt seal using a rate between 0.10 to 0.20 gal per square yard as determined by the Project Manager.

Treated Subgrade temperature must remain above 40 °F during the entire curing period.

306.3.3.3 Final Mixing

The Contractor shall ensure, by additional pulverization, that the stabilized lime-soil mixture meets the requirements of Table 306.3.3.3:1, "Lime-Treated Subgrade Gradation Requirements" before final compaction.

**Table 306.3.3.3:1
Lime-Treated Subgrade Gradation Requirements**

Sieve size	% passing
One (1) inch	100.0
No. 4	60.0 – 100.0

306.3.3.4 Finishing Operations

The Contractor shall:

1. Compact the treated Subgrade, immediately after final mixing is complete, to 95% of the maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Project Manager will verify the compacted depth of lime-treated Subgrade with a Contractor-provided phenolphthalein indicator chemical or

- beet juice.
- 2. Finish the treated Subgrade to ± 0.1 ft along the centerline and ± 0.05 ft at right angles from centerline.
- 3. Lightly roll the completed section to prevent hairline cracking.

306.3.4 Protection of Treated Subgrade

The Contractor shall:

- 1. Allow only sprinkling or spraying Equipment, on the treated subgrade during the curing period, unless otherwise approved by the Project Manager.
- 2. Install a base, Sub-base, or wearing surface before opening the Roadway to the public, unless otherwise approved by the Project Manager.

306.4 METHOD OF MEASUREMENT

The Department will pay for lime as Hydrated Lime using the following conversion:

- 1. One (1) ton of quicklime equals 1.3 ton of hydrated lime.

306.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Cement-Treated Subgrade</i>	Square Yard
<i>Portland Cement</i>	Ton
<i>Lime Treated Subgrade</i>	Square Yard
<i>Hydrated Lime, per Section 402</i>	Ton

306.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

- 1. Preparing the Roadbed;
- 2. Providing, applying, mixing and processing Portland Cement or Lime and compacting the mixture;
- 3. Correcting soft areas and reshaping the subgrade before adding cement or lime; and
- 4. Ensure scarified depth of the treated subgrade (shown in the plans) is free of deleterious material and stones retained on three (3.0) inch sieve.

DIVISION 400 – SURFACE TREATMENTS AND PAVEMENTS

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SECTION 401: PAVEMENT SMOOTHNESS MEASUREMENT

401.1 DESCRIPTION

This Work consists of providing and using profile testing Equipment that incorporates the Mean Roughness Index (MRI) measurement for the established categories provided within this Section. The MRI is the average International Roughness Index (IRI) of left and right wheel paths.

Unless otherwise specified in the Contract, Category One (1) Table 401.5.1.1:1, "MRI Based Profile Pay Adjustment Schedule for Category I HMA/WMA Projects," will be applicable to all Hot Mix Asphalt (HMA)/Warm Mix Asphalt (WMA) Projects. Unless otherwise specified in the Contract, Table 401.5.1.2:1, "MRI Based Profile Pay Adjustment Schedule for PCCP Projects" – Category I will be applicable to all Portland Cement Concrete Pavement (PCCP) Projects.

This Specification applies to all construction Projects, with one (1) opportunity for pavement smoothness. An example of one (1) opportunity for pavement smoothness is a single lift of paving operations for HMA/WMA or PCCP.

References to Open Graded Friction Course (OGFC) in Section 401, "Pavement Smoothness Measurement" include OGFC, WMA-OGFC, and Rubberized Open Graded Friction Course (ROGFC).

401.2 MATERIALS—Reserved

401.3 CONSTRUCTION REQUIREMENTS

401.3.1 Inertial Profiler

The Contractor shall provide an inertial profiler that meets the requirements of AASHTO M 328 "Inertial Profiler," or a State Materials Bureau's approved equal. The Inertial Profiler shall use dual height and vertical acceleration sensors. The height sensors shall have a centerline distance of seventy (70.0) inches \pm one (1.0) inch between sensors.

401.3.1.1 Inertial Profiler Calibration and Certification

The inertial profiler shall be certified in accordance with the Department's *Standard Practice "Certification of Inertial Profilers."* Inertial Profiler used for Acceptance testing on NMDOT Projects shall have a current TTCP annual calibration sticker or manufacturer's calibration and certification certificate. The manufacturer's certificate is valid only until the date of the next TTCP sponsored profile measuring device certification.

The Contractor shall verify the accuracy of the horizontal and vertical sensors daily in accordance with the manufacturer's and TTCP procedures. If the inertial profiler is used on multiple Projects in one (1) day, verification of the horizontal and vertical sensors will be required before use on each Project. The Contractor shall perform verifications in the presence of the representative designated by the Project Manager. The Project Manager may require additional verifications. The Contractor shall provide documentation to the Project Manager and maintain copies of the verifications documentation and manufacturer's procedures.

The Contractor shall remove the inertial profiler from the Project if it does not meet the manufacturer's verification and calibration requirements. The Project Manager will report the TTCP inertial profiler certification number to the TTCP Administrator in order to provide

notification that the Contractor cannot use the machine on other Projects until inertial profiler obtains re-certification. Once the manufacturer re-certifies the inertial profiler, provide a copy of the certificate to the Department's TTCP Administrator. The TTCP Administrator will provide a temporary TTCP certification valid until the next scheduled certification.

401.3.1.2 Technician Certification

The Department's TTCP will certify individuals performing profile measurement. The Department will base certification on demonstrated ability and a written test. The TTCP will establish the term and expiration date of certification and requirements for renewal. The Department State Materials Engineer, through the TTCP, will investigate any concerns submitted in writing as to the competence of a certified individual and implement corrective action if necessary in accordance with the TTCP Board of Directors established procedures.

401.3.1.3 Profile Measurements

The Department will consider profile testing as part of the paving operation.

The Contractor shall provide the proposed frequency and schedule for profile testing to the Project Manager no later than the Pre-Paving Conference.

The Contractor shall collect raw profile data utilizing the initial profiler's settings used during the TTCP "Certification of Inertial Profilers" process. For HMA/WMA/OGFC data collection, an upper wavelength cutoff filter of 300 feet shall be applied. For PCCP data collection, the Contractor shall use a Butterworth Band-Pass filter short cutoff wavelength of 0.5 ft and a long cutoff wavelength of 300 ft. The Contractor shall allow the Department's Representative to witness the collection of raw data by riding in the vehicle while collecting the data.

The Contractor shall export all raw profile data to create files conforming to the University of Michigan Transportation Research Institute's Engineering Research Division (ERD) format. The Contractor shall provide the collected data in ERD format, along with the current calibration documentation on either a CD or Universal Serial Bus (USB) memory storage device to the accompanying Department representative, within one (1) hour after the data has been collected. The Contractor shall provide additional data files or text files upon request by the Project Manager or Department's Representative.

If the Contractor does not submit the profile measurements files within one (1) hour, the Department may alter the Pay Adjustments according to the pavement type and category established for the Project by applying an additional five percent (5%) price deduction to the total price reduction for the Profiled area in question.

The Contractor shall maintain the profile data files. Take additional profiles to retest paved surfaces that have received corrective Work. The Project Manager may require additional profiles to check previously submitted data or to identify the limits of surface irregularities. The Contractor shall include the following information for each data file:

1. Project number,
2. Date,
3. Lane profiled,
4. Beginning and ending stations,
5. Net total linear feet of each lane,
6. Filter settings, and

7. Operator's signature.

401.3.1.4 Inertial Profiler Operations

The Contractor shall obtain the Project Manager's approval and sweep the Roadway surface before beginning profile operations.

The Contractor shall operate and maintain the inertial profiler in accordance with AASHTO R 57 "Operating Inertial Profiling Systems" and manufacturer's recommendations and procedures established by TTCP. The inertial profiler shall be equipped with dual-sensors, bar lasers up to four (4.0) inches long, that measures the profile traces for each wheel path.

The Contractor shall measure the longitudinal smoothness of the final surface of HMA, WMA, OGFC, and PCCP using a Department certified inertial profiler. The Contractor shall operate the device on the driving surface of the Roadway at the manufacturer's recommended speed without interfering with traffic or its own operation.

The Contractor shall measure the profile traces for each wheel path at the outside trace three (3) feet from and parallel to the approximate location of the pavement edge line.

For the transverse joints, at the beginning of Project (BOP) and end of project (EOP), the first one hundred (100) feet before and after the transverse joint shall be excluded from the data used to determine price adjustments. For Bridge approach and departure tie-ins, the one hundred (100) feet before approach and after departure shall be excluded from the data used to determine price adjustments. The areas excluded shall be evaluated in accordance with Section 401.3.1, "Straightedge Measurements (Category III)." See Section 401.5.1, "Pay Adjustments" for more information.

On HMA/WMA/OGFC Projects, the Contractor shall perform profile measurements and corrective actions on the final surface of HMA/WMA. The final surface is the surface immediately behind the paving operations prior to any surface modification. PCCP Projects, perform profile measurements and corrective actions on the finished surface after tining or grooving.

401.3.1.5 ProVAL Profile Data Analysis by the Department

The Department will use the current version of "ProVAL" software to determine the MRI for each 0.1 mile section of each lane, reported to the nearest 0.1 inch per mile using the average of the two (2) wheel paths' IRI's, using Ride Quality Analysis. Using the ProVAL software, the Department will apply the 250 mm filter in "ProVAL." The Contractor shall export the data with no filters applied. Data obtained through analysis by the Department will be used for evaluations of all "Must Grind Work," "Corrective Work," and "Pay Adjustments."

401.3.2 Straightedge Measurements (Category III)

The Contractor shall test the final surface of HMA, WMA, or PCCP with an approved profile measurement device that complies with Section 401.3.1, "Inertial Profiler." The Project Manager will analyze the profile in the current version of ProVAL utilizing the Rolling Straightedge with a ten (10) foot straightedge length and Deviation Threshold of 0.25 inches. The Contractor shall correct surface deviations greater than ¼ inch within ten (10) ft, as directed by the Project Manager.

Upon completion of the profile measurement and before corrective measures, the Contractor may request in writing for approval by the Project Manager to drive the area

profiled with the Project Manager to verify any surface deviations. Areas in question shall be validated with a ten (10) foot mechanical straightedge at both right angles and parallel to centerline to validate ¼ inch surface deviation. Areas ¼ inch and greater surface deviation in ten (10) feet shall be corrected.

In lieu of a profile measurement device the Contractor may request in writing for approval by the Project Manager to use a physical ten (10) foot straightedge. If approved the Contractor shall use Contractor's personnel, to measure with a physical ten (10) foot straightedge measurement at both right angles and parallel to the centerline, advancing the straightedge in five (5) foot increments in the presence of the Project Manager or his designee. The Contractor shall correct surface deviations greater than ¼ inch within ten (10) ft, as directed by the Project Manager.

Failure by Contractor to correct any and all validated surface deviations ¼ inch and greater will result in a fifty percent (50%) price reduction to all the HMA, WMA, or PCCP for the Project.

401.3.3 Evaluation for Must Grind Work and Corrective Work

The Contractor shall evaluate the pavement in 0.1-mile sections for determining needed Must Grind Work, Corrective Work, and Pay Adjustments.

401.3.4 Diamond Grinding

Diamond grinding Equipment uses diamond tipped saw blades, composed of industrial diamonds and metallurgical powder that are gang mounted on a cutting head ranging in width from 36 inches to 48 inches. The diamond grinding Equipment shall use water to cool the cutting head. The slurry or residue resulting from the grinding operation shall be continuously removed from the pavement with a wet vacuum process. The slurry or residue shall not be allowed to flow across lanes occupied by traffic or to flow into gutters or other drainage facilities. Diamond grinding Equipment shall be self-propelled, self-contained and without external attachments acting as cutting / grinding devices.

Diamond grinding operations of the final HMA/WMA lift shall not dislodge aggregate or binder creating rock pockets or deviations on pavement surface. If occurring, the Contractor shall cease operation and notify the Project Manager and submit a corrective action Plan for approval.

401.3.5 Corrective Work/Must Grind Work

The Contractor shall identify potential must grind locations using "Ride Quality Analysis" under the "Analysis Type" with the "Continuous" feature of the latest version of the FHWA's "ProVAL" software. The Contractor shall use a MRI threshold (inch/mi) of 105.00 and a segment length of 25.00 feet. The Contractor shall identify must grind locations for each lane using the "MRI" Ride Quality Index feature of ProVAL. Any locations with a MRI of 105.00 to 140.00 will be evaluated by the Project Manager and the Contractor, to determine if diamond grinding is required, final determination will be made by the Project Manager. All locations with an MRI above 140.00 must be corrected. Localized roughness defining the must grind areas shall be limited to the extent of the area to be corrected. Must grinds shall not extend the entire length of the 0.1-mile section.

The Contractor shall develop a written corrective Work/must grind Plan and submit for approval by the Project Manager. This plan shall include methods and procedures to be utilized to achieve the specified MRI values for "Corrective Work Required" (CWR) sections for

the specified category indicated in the Contract or determined to be a must grind. Upon approval of the Plan, the Contractor shall complete corrective Work/must grinds, including necessary traffic control, at no additional cost to the Department. After completion of the corrective Work/must grinds, re-profile the corrected area to verify compliance with Specification requirements. Re-profiled areas will receive a maximum pay adjustment of 0.00 (\$/sy).

The Contractor shall limit corrective Work/must grinds to diamond grinding, overlaying, or removing and replacing rejected 0.1-mile sections. The Contractor shall not begin corrective Work/must grinds until the Project Manager approves the methods and procedures in writing. The Project Manager's approval does not relieve the Contractor of the responsibility to comply with the Specifications.

The Contractor shall perform corrective Work/must grinds in accordance with the following:

1. Surface Diamond Grinding. Use diamond grinding to bring the measured "CWR" or must grind areas in accordance with the applicable table(s), category (ies), and Specifications as indicated in the Contract.

Grind corrective Work/must grind areas to produce a smooth transition to the surrounding pavement. If the corrective Work or must grind areas are not the full width of the lane, only half of the lane containing the corrective Work or must grind area shall be ground and smoothly feathered into the surrounding pavement.

Do not reduce planned pavement thickness by more than 0.3 inches without written approval of the Project Manager.

For HMA/WMA, if the Contract does not require an OGFC/ROGFC/WOGFC, or OGFC will not be placed before Project Suspension, apply a fog seal to the ground areas as approved by the Project Manager. All operations necessary to apply fog seal will be incidental to the Bid Item Unit Price for HMA/WMA; the Department will make no separate payment.

For PCCP, perform additional diamond grinding as necessary in the following situations:

- 1.1. The transverse direction, so the lateral diamond grinding limits are at a constant offset from and parallel to the nearest lane line or pavement edge; and
 - 1.2. The longitudinal direction, so the diamond grinding begins and ends at lines perpendicular to the pavement centerline. Maintain diamond grinding locations as neat rectangular areas of uniform appearance. If tining is eliminated by diamond grinding, machine groove the hardened concrete in the same pattern as adjacent tining at no additional cost to the Department.
2. Overlaying. If the Contractor uses an additional lift of HMA/WMA to correct rough pavement, the HMA/WMA shall meet the requirements of the appropriate Specification. Extend the overlay lift the full width of the underlying pavement surface to a finished compacted thickness sufficient to correct the existing pavement roughness.
The Department will not allow a second overlay if the first overlay does not meet the longitudinal smoothness requirement.
Correct a corrective overlay that does not meet the smoothness requirement by diamond grinding or removing and replacing as specified in Section 401.3.5, "Corrective Work/Must Grind Work."
 3. Removing and Replacing. Remove pavement the full width of the lane and the full thickness of the course. The removal area shall begin and end with a transverse

saw cut perpendicular to centerline. Use the type of approved HMA, WMA or PCCP as originally specified in the Project Contract as replacement Material.

4. Extrapolation. For Category I and II, after grinding, in lieu of items 2 and 3 above, the Contractor may use this option with the Project Manager and District Construction Engineer's approval. The Contractor may request in writing, areas in CWR to remain in place and use an extrapolated value from the appropriate Table ## below.

The Contractor shall re-profile the 0.1 mile section of travel lane after performing corrective Work/must grinds and use the re-profile's reported measured smoothness data to represent the particular section for Pay Adjustment purposes in accordance with Section 401.5, "Basis of Payment."

401.3.6 OGFC Placement and Profile Measurement

The Contractor shall ensure HMA/WMA profile measurements, corrective work/must grinds have been completed before placing OGFC. Pay Adjustment will be based on the MRI of the final surface of HMA/WMA unless the measured MRI of the OGFC is greater than the measured MRI of the HMA/WMA on the same 0.1 mile section, then the Department will base the Pay Adjustment for the HMA/WMA section on the OGFC's measured MRI.

401.3.7 Independent Assurance Testing

The Department may perform Independent Assurance testing with a Department certified Inertial Profiler from a District Laboratory in order to verify and compare Contractor obtained data.

401.4 METHOD OF MEASUREMENT

The Department will determine smoothness Pay Adjustments on the calculated square yards of the surface area of the travel lane bound by the plan typical section travel lanes and 0.1-mile lane length.

401.5 BASIS OF PAYMENT

Surface smoothness testing and corrective Work/must grinds to bring the final surface within Specification smoothness in accordance with the applicable table(s) and category (ies) as indicated in the Contract is Incidental to the Bid Item Unit Price for HMA, WMA, or PCCP; the Department will make no separate payment. All traffic control required to determine and correct pavement smoothness is Incidental to the HMA, WMA, or PCCP item.

All adjustments of manhole and utility valves for the facilitation of pavement smoothness shall be performed after paving of the finish grade. This Work shall be paid in accordance with Section 662, "Manholes" and 663 "Utility Items."

401.5.1 Pay Adjustments

The Department will calculate a Pay Adjustment for each 0.1 mile section of travel lane. The Pay Adjustments will apply to the total Accepted area of each 0.1 mile section of HMA, WMA, or PCCP constructed for the Plan typical section travel lane width and Roadway length.

The Department will not include the following areas for payment adjustment purposes:

1. BOP and EOP transverse joint (tie-in) of existing pavement (100 feet on each side of transverse joint);

2. Bridge approach and departure tie-in (100 feet before and after approach and departure); and
3. Shoulders and turnouts.

The Contractor shall follow the requirements of Section 401.3.2, "Straightedge Measurements (Category III)" for areas one (1) and two (2) listed above. The Pay Adjustment will be determined utilizing the MRI data obtained after corrective Work/must grinds in accordance with Section 401.3.5, "Corrective Work/Must Grind Work" has been completed. Re-profiled areas will receive a maximum pay adjustment of 0.00(\$/sy). Pay Adjustment for a 0.1 mile section greater than 0.00(\$/sy) will be utilized to determine the overall Pay Adjustment for smoothness of the Project. If the overall Pay Adjustment calculated is greater than 0.00, the Pay Adjustment for smoothness will be 0.00 (\$/sy).

401.5.1.1 Pay Adjustment for Category I and Category II HMA/WMA Projects

The Department will base Pay Adjustments on the final MRI for each 0.1 mile section in accordance with Table 401.5.1.1:1, "MRI Based Profile Pay Adjustment Schedule for Category I HMA/WMA Projects" and Table 401.5.1.1:2, "MRI Based Profile Pay Adjustment Schedule for Category II HMA/WMA Projects," after the Contractor performs and measures corrective Work. Re-profiled areas will receive a maximum pay adjustment of 0.00 (\$/sy).

**Table 401.5.1.1:1
MRI Based Profile Pay Adjustment Schedule
for Category I HMA/WMA/OGFC Projects**

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category I
<46.1			+0.24
46.1	To	47.0	+0.20
47.1	To	48.0	+0.16
48.1	To	49.0	+0.12
49.1	To	50.0	+0.08
50.1	To	51.0	+0.04
51.1	To	52.0	0.00
52.1	To	53.0	-0.14
53.1	To	54.0	-0.28
54.1	To	55.0	-0.42
55.1	To	56.0	-0.56
56.1	To	57.0	-0.70
57.1	To	58.0	-0.84
58.1	To	59.0	-0.98
59.1	To	60.0	-1.12
>60.0			Corrective Work Required

Table 401.5.1.1:1
MRI Based Profile Pay Adjustment Schedule
for Category I HMA/WMA/OGFC Projects

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category I
60.1	to	61	-1.26
61.1	to	62	-1.40
62.1	to	63	-1.54
63.1	to	64	-1.68
64.1	to	65	-1.82
65.1	to	66	-1.96
66.1	to	67	-2.10
67.1	to	68	-2.24
68.1	to	69	-2.38
69.1	to	70	-2.52
70.1	to	71	-2.66
71.1	to	72	-2.80
72.1	to	73	-2.94
73.1	to	74	-3.08
74.1	to	75	-3.22
75.1	to	76	-3.36
76.1	to	77	-3.50
77.1	to	78	-3.64
78.1	to	79	-3.78
79.1	to	80	-3.92
80.1	to	81	-4.06
81.1	to	82	-4.20
82.1	to	83	-4.34
83.1	to	84	-4.48
84.1	to	85	-4.62
85.1	to	86	-4.76
86.1	to	87	-4.90
87.1	to	88	-5.04
88.1	to	89	-5.18

Table 401.5.1.1:1
MRI Based Profile Pay Adjustment Schedule
for Category I HMA/WMA/OGFC Projects

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category I
89.1	to	90	-5.32
90.1	to	91	-5.46
91.1	to	92	-5.60
92.1	to	93	-5.74
93.1	to	94	-5.88
94.1	to	95	-6.02
95.1	to	96	-6.16
96.1	to	97	-6.30
97.1	to	98	-6.44
98.1	to	99	-6.58
99.1	to	100	-6.72
100.1	to	101	-6.86
101.1	to	102	-7.00
102.1	to	103	-7.14
103.1	to	104	-7.28
104.1	to	105	-7.42
105.1	to	106	-7.56
106.1	to	107	-7.70
107.1	to	108	-7.84
108.1	to	109	-7.98
109.1	to	110	-8.12

Table 401.5.1.1:2
MRI Based Profile Pay Adjustment Schedule
for Category II HMA/WMA/OGFC Projects

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category II
<56.1			+0.18
56.1	To	57.0	+0.15
57.1	To	58.0	+0.12

**Table 401.5.1.1:2
MRI Based Profile Pay Adjustment Schedule
for Category II HMA/WMA/OGFC Projects**

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category II
58.1	To	59.0	+0.09
59.1	To	60.0	+0.06
60.1	To	61.0	+0.03
61.1	To	62.0	0.00
62.1	To	63.0	-0.12
63.1	To	64.0	-0.24
64.1	to	65.0	-0.36
65.1	to	66.0	-0.48
66.1	to	67.0	-0.60
67.1	to	68.0	-0.72
68.1	to	69.0	-0.84
69.1	to	70.0	-0.96
70.1	to	71.0	-1.08
71.1	to	72.0	-1.20
72.1	to	73.0	-1.32
73.1	to	74.0	-1.44
>74.0			Corrective Work Required
74.1	to	75	-1.56
75.1	to	76	-1.68
76.1	to	77	-1.80
77.1	to	78	-1.92
78.1	to	79	-2.04
79.1	to	80	-2.16
80.1	to	81	-2.28
81.1	to	82	-2.40
82.1	to	83	-2.52
83.1	to	84	-2.64
84.1	to	85	-2.76
85.1	to	86	-2.88

**Table 401.5.1.1:2
MRI Based Profile Pay Adjustment Schedule
for Category II HMA/WMA/OGFC Projects**

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category II
86.1	to	87	-3.00
87.1	to	88	-3.12
88.1	to	89	-3.24
89.1	to	90	-3.36
90.1	to	91	-3.48
91.1	to	92	-3.60
92.1	to	93	-3.72
93.1	to	94	-3.84
94.1	to	95	-3.96
95.1	to	96	-4.08
96.1	to	97	-4.20
97.1	to	98	-4.32
98.1	to	99	-4.44
99.1	to	100	-4.56
100.1	to	101	-4.68
101.1	to	102	-4.80
102.1	to	103	-4.92
103.1	to	104	-5.04
104.1	to	105	-5.16
105.1	to	106	-5.28
106.1	to	107	-5.40
107.1	to	108	-5.52
108.1	to	109	-5.64
109.1	to	110	-5.76
110.1	to	111	-5.88
111.1	to	112	-6.00
112.1	to	113	-6.12
113.1	to	114	-6.24
114.1	to	115	-6.36

**Table 401.5.1.1:2
MRI Based Profile Pay Adjustment Schedule
for Category II HMA/WMA/OGFC Projects**

Pay Adjustment (\$ per square Yard)			
MRI (Mean Roughness Index) inch/0.1mi			Category II
115.1	to	116	-6.48
116.1	to	117	-6.60
117.1	to	118	-6.72
118.1	to	119	-6.84
119.1	to	120	-6.96
120.1	to	121	-7.08
121.1	to	122	-7.20
122.1	to	123	-7.32
123.1	to	124	-7.44

401.5.1.2 Pay Adjustment for Category I and Category II PCCP Pavement Projects

The Department will base Pay Adjustments and credit adjustments on the final average MRI for each 0.1 mile section in accordance with Table 401.5.1.2:1, "MRI Based Profile Pay Adjustment and Credit Adjustment Schedule for PCCP Projects," after the Contractor performs and measures corrective Work. Re-profiled areas will receive a maximum pay adjustment of 0.00(\$/sy). Credits will not result in positive payment. Maximum positive payment is \$0.00.

**TABLE 401.5.1.2:1
MRI Based Profile Pay Adjustment Schedule
for PCCP Projects**

Category II (Speed < 45 MPH)		Category I (Speed ≥ 45 MPH)	
MRI	Adjustment	MRI	Adjustment
<55	Credit Adjustment +\$0.56/sq yd	<40	Credit Adjustment +\$0.56/sq yd
55 to 74	Credit Adjustment ((75-MRI)*0.1125)/4	40 to 59	Credit Adjustment ((60-MRI)*0.1125)/4
75 to 90	0	60-75	0
91 to 110	Pay Adjustment (90-MRI)*0.1125	76 to 90	Pay Adjustment (75-MRI)*0.1125
>110	Corrective Action	>90	Corrective Action

401.5.1.3 Pay Adjustment for Category III HMA/WMA/OGFC/PCCP Projects

Failure by Contractor to correct any and all validated surface deviations ¼ inch and greater will result in a fifty percent (50%) price reduction to all the HMA, WMA, OGFC, or PCCP for the Project.

SECTION 402: ASPHALT MATERIALS AND MINERAL ADMIXTURES

402.1 DESCRIPTION

This Work consists of providing, mixing, and applying asphalt Materials and mineral admixtures (hydrated lime, anhydrite based Material, Portand cement or lubricating antistripping additive).

402.2 MATERIALS

402.2.1 Asphalt Binder

Asphalt binders are uncracked petroleum asphalts. The Supplier shall prepare asphalt binders by refining petroleum at a maximum temperature of 700 °F. The Supplier shall not use Materials that are prone to cracking. The asphalt binder will be:

1. Free of thermal decomposition products;
2. Free of residue from non-asphalt sources;
3. Homogeneous and free from water;
4. Non-foaming when heated to 350 °F; and
5. Conforming to the requirements of performance-graded asphalt binder.

402.2.1.1 Performance-Graded Asphalt Binder (PGAB)

The Supplier shall provide performance-graded asphalt binder in accordance with AASHTO M 320. The Contractor may substitute a performance-graded asphalt binder with a high-end or low-end temperature grade in excess of that shown in the Plans, at no additional cost to the Department.

402.2.1.2 Polymer-Modified Asphalt Binder

The Contractor shall provide a Polymer-Modified Asphalt Binder that meets the requirements for a PG 76-22+, PG 76-28+, PG 70-22+, PG 70-28+, PG 76-28R+ and PG 70-28R+ per AASHTO M 320 in addition to the requirements in Table 402.2.1.2:1, "Polymer-Modified Asphalt Binders."

**Table 402.2.1.2:1
Polymer-Modified Asphalt Binders**

Properties	Requirements	
		PG 76-22+, PG 76-28+, PG 70-22+ PG 70-28+
Terminal-Blended Tire Rubber Content, % minimum	-----	5.0

**Table 402.2.1.2:1
Polymer-Modified Asphalt Binders**

Styrene-Butadiene-Styrene (SBS) Polymer Content by Weight of Total Formulation, % minimum	-----	2.0
Solubility in Trichloroethylene, % minimum (Note 1), ASTM D 2042	97.5	97.5
Elastic Recovery @ 77°F, % minimum, AASHTO T 301	65	65

Note 1: If the solubility of the binder is less than 97.5 percent, test the base asphalt binder. The solubility of the base asphalt binder shall be greater than 99 percent.

402.2.1.3 Tire Rubber Modifier (TRM)

Tire rubber modifier (TRM) shall be produced from the recycling of automobile and/or truck tires. The specific gravity of the TRM shall be 1.15 +/- 0.05. The fiber content shall be less than 0.5% by weight for all other applications. The TRM shall contain no metal particles. Mineral contaminants shall be less than 0.25% by weight.

402.2.1.3.1 Asphalt Rubber Binder Formulation Design

The asphalt rubber binder shall contain a minimum of five percent (5%) TRM. The terminal-blended asphalt rubber binder shall conform to the requirements of AASHTO M320, as well as the requirements in Table 402.2.1.2:1, "Polymer-Modified Asphalt Binders." The Asphalt Rubber Binder Supplier shall perform the design for the asphalt rubber binder formulation. Testing shall be the responsibility of the Contractor, at no additional cost to the Department.

The Contractor shall provide the State Materials Bureau with a copy of the terminal-blended asphalt rubber binder formulation design at the time of mix design submittal.

The design shall include:

1. Source;
2. Grade;
3. Type;
4. Proportion expressed as a percentage of total weight of the formulation for each component material;
5. Physical properties of the asphalt rubber binder in accordance with Table 402.2.1.2:1, "Polymer-Modified Asphalt Binders;" and
6. Recommended mixing and compaction temperatures for intended use.

402.2.1.4 Shipping

The Contractor shall:

1. Ship asphalt Material in sealed, insulated tank vehicles with convenient access to the Material so that it may be sampled;

2. Keep the shipping tanks free of foreign matter. The Department will reject contaminated asphalt Material;
3. Ship the performance-graded binder as shown in the requirements of Department's *Standard Practice for Certifying Suppliers of Performance-Graded Asphalt Binders* and in accordance with Section 402.2.1.1, "Performance-Graded Asphalt Binder (PGAB)."

402.2.1.5 Sampling and Testing

402.2.1.5.1 Sampling of Asphalt Binder

The Contractor shall perform all Quality Assurance sampling using AASHTO T 40, Standard Method of Test for Sampling Bituminous Materials under the direct supervision of TTCP certified sampling personnel, and witnessed by the Project Manager or his designee. The samples will be taken either from the discharge side of the storage tank or from the delivery trucks. The samples will be taken after a sufficient amount, a minimum of one (1) gallon, of PGAB is run out to clear any residual PGAB or other asphalt Material and/or solvent that may have built up in the sampling valve. All approved sample containers shall be identified using Department Form A-1231.

The minimum sampling frequency for asphalt cement shall be one (1) sample during the test strip operation and every 5000 tons of HMA or WMA thereafter. One (1) sample of asphalt cement shall be taken representing OGFC, WOGFC, or ROGFC operations. A minimum of two (2) samples shall be taken per Project representing asphalt binder from HMA or WMA, and a minimum of one (1) sample representing asphalt binder for OGFC, WOGFC, or ROGFC. A sample shall consist of (3) separate one (1)-quart sub-samples. All samples shall be maintained in a secure, dry location at the Project office or at a pre-agreed upon location that is satisfactory to the Contractor and Project Manager.

402.2.1.5.2 Testing of Asphalt Cement

The Contractor shall sample and test performance-graded asphalt binders in accordance with the Department's *Standard Practice for Certifying Suppliers of Performance-Graded Asphalt Binders* and in accordance with Section 402.2.1.1, "Performance-Graded Asphalt Binder (PGAB)." The Department will assume no obligation to Accept the CTR's and may additionally test the certified Materials. The Department may test asphalt Materials at the manufacture shipping or Project storage location.

One (1) sub-sample shall be tested by NMDOT Chemistry Unit when the test strip is performed. Another randomly selected sub-sample shall be tested by the NMDOT Chemistry Unit during the course of the Project.

If the results of any of the sub-samples designate failing material, the second sub-sample shall be submitted to and tested by the NMDOT Chemistry Unit. If the second sub-sample does not meet Specifications in accordance with AASHTO M 320, Table 402.2.1.6:1, "Pay Adjustment Factor Based on PGAB Test Results" will be implemented by the Project Manager. The Pay Adjustment Factor will represent the total asphalt binder used for 5000 Tons of HMA or the tonnage of HMA used for the test strip. If there are multiple failures for each binder test on the same sample, the Project Manager will base the adjustment on the lowest pay factor of all the tests. The Price Adjustment will be executed with a Change Order (Field Sheet).

402.2.1.5.3 Appeal Procedure (Asphalt Binders – Only)

If desired, the Supplier at no expense to the Department may submit the third sub-sample (referee) to a mutually agreed upon Independent Laboratory. The Independent Laboratory shall be currently accredited to perform such testing by the AASHTO Accreditation Program (AAP).

If the Supplier desires to appeal the price adjustment for a particular PGAB grade production lot (5000 Tons of HMA or WMA), the Supplier shall submit a written request to the Project Manager, with a copy to the QC Engineer, within ten (10) Calendar Days of the reported test results. The request must describe in full the grounds of circumstances for the appeal. The appeal request will be reviewed by the Project Manager and Assistant District Engineer - Construction and either Accepted or denied. If the appeal is denied, a letter from the Project Manager stating the grounds for denial will be sent to the Contractor and the price adjustment will be executed with a Change Order (Field Sheet).

402.2.1.6 Acceptance

The Department will Accept asphalt cement in accordance with the Department's *Standard Practice for Certifying Suppliers of Performance-Graded Binders* and in accordance with Section 402.2.1.1, "Performance-Graded Asphalt Binder (PGAB)."

**TABLE 402.2.1.6:1
Pay Adjustment Factor¹
Based on Binder Test Results**

Binder Property	Measured Value	Pay Factor Applied
DSR on Original Binder G*/sinδ (kPa) Min. 1.00 kPa	<1.00 – 0.98	0.98
	<0.98 – 0.96	0.95
	<0.96 – 0.94	0.92
	<0.94 – 0.90	0.85
	<0.90	0.75 or Removal ²
DSR on RTFO Aged Material G*/sinδ (kPa) Min. 2.20 kPa	<2.20 – 2.15	0.98
	<2.15 – 2.09	0.95
	<2.09 – 2.02	0.92
	<2.02 – 2.00	0.85
	<2.00	0.75 or Removal ²
DSR on PAV Aged Material G*□sinδ (kPa) Max. 5000 kPa	>5000 – 5100	0.98
	>5100 – 5250	0.95
	>5250 – 5400	0.92
	>5400 – 5600	0.85
	>5600	0.75 or Removal ²
BBR Slope value (m) of PAV Aged Binder Min. 0.300	<0.300 – 0.298	0.98
	<0.298 – 0.293	0.95
	<0.293 – 0.290	0.92
	<0.290 – 0.285	0.85
	<0.285	0.75 or Removal ²
BBR Stiffness of PAV Aged Binder S (MPa)	>300 – 306	0.98
	>306 – 315	0.95

**TABLE 402.2.1.6:1
Pay Adjustment Factor¹
Based on Binder Test Results**

Binder Property	Measured Value	Pay Factor Applied
Max. 300 MPa	>315 – 324	0.92
	>324 – 330	0.85
	>330	0.75 or Removal ²
% Elastic Recovery on RTFO Aged Material ³ Min 65%	<65 – 60	0.95
	<60	0.75 or Removal ²
¹ Price Reduction will be applied to Contactor's invoice price of asphalt binder. ² The Assistant District Engineer - Construction will determine if the non-compliant HMA Material will be removed. Removal and replacement will be at no additional cost to the department. If the non-compliant Material is Accepted, a price reduction factor of 0.75 will apply. ³ Elastic-Recovery is only applicable to PG+ and PGR+ Binders.		

402.2.2 Emulsified Asphalt

Emulsified asphalt consists of uncracked petroleum asphalt uniformly emulsified with water and an emulsifying or stabilizing agent. The Contractor shall ensure that emulsified asphalt is homogenous after mixing. The Supplier shall provide anionic emulsified asphalt in accordance with AASHTO M 140 and cationic emulsified asphalt in accordance with AASHTO M 208.

402.2.2.1 High-Float Emulsions

The Supplier shall provide high-float emulsions (HFE-60, HFE-90, HFE-150, and HFE-300) in accordance with Table 402.2.2.1:1, "High-Float Emulsions Requirements."

**Table 402.2.2.1:1
High-Float Emulsions Requirements**

Test	HFE-60	HFE-90	HFE-150	HFE-300
Viscosity, Saybolt Furol at 122 °F, Seconds	50+	50+	50+	50+
Sieve Test, Retained on No. 20 Sieve, %	0.10-	0.10-	0.10-	0.10-
Settlement, 5 Days, %	5-	5-	5-	5-
Storage Stability Test, 1 Day, %	1-	1-	1-	1-
Demulsibility, 1.2 fl oz 0.10 N, CaCl, %	30+	30+	—	—
Residue from Distillation Test to 500 °F	65+	65+	65+	65+
Oil Distillate by Volume of Emulsion, %	1-	3-	7-	7-
Coating Test, 3 minutes	Grades, stones coated thoroughly			
Tests on Residue from Distillation Test				
Penetration at 77 °F, 3.5 oz., 5 sec, 0.1 mm	60–90	90–150	150–300	300+
Float Test at 140 °F, Seconds	1,200+	1,200+	1,200+	1,200+

402.2.2.2 Polymer-Modified High-Float Emulsions

This Material is a high-float emulsion containing polymer-modified asphalt and water in accordance with the requirements of Table 402.2.2.2:1, "Polymer-Modified High-Float Emulsions Requirements."

**Table 402.2.2.2:1
Polymer-Modified High-Float Emulsions Requirements**

Test	HFE-60P	HFE-100P	HFE-150P	HFE-300P
Viscosity, Saybolt Furol at 122 °F, Seconds	50+	50+	50+	50+
Sieve Test, Retained on No. 20 Sieve, %	0.10-	0.10-	0.10-	0.10-
Storage Stability Test, 1 Day, %	1-	1-	1-	1-
Demulsibility, 1.2 fl oz 0.10 N, CaCl, %	30+	30+	—	—
Residue from Distillation Test to 400 °F	65+	65+	65+	65+
Oil Distillate by Volume of Emulsion, %	1-	3-	7-	7-
Tests on Residue from Distillation Test				
Penetration at 77 °F, 3.5 oz., 5 s, 0.1 mm	60–90	90–150	150–300	300+
Ductility 77 °F, 2 inch/min	40+	40+	40+	—
Elastic Recovery, %	55+ ^a	58+ ^a	25+ ^b	25+ ^b
Float Test @ 140 °F, Seconds	1,200+	1,200+	1,200+	1,200+

^aTest in accordance with AASHTO T 301 at a test temperature of 50 °F.
^bTest in accordance with AASHTO T 301 at a test temperature of 39.2 °F.

402.2.2.3 Polymer-Modified High-Float Emulsion, Rapid Set

The Supplier shall provide a high-float rapid-set, polymerized emulsion (HFRS-2P) that contains polymer-modified asphalt, water, and an emulsifier. The Supplier shall provide high-float rapid-set, polymerized emulsion (HFRS-2P) in accordance with Table 402.2.2.3:1, "Rapid-Set Polymer-Modified High-Float Emulsion Requirements."

**Table 402.2.2.3:1
Rapid-Set Polymer-Modified High-Float Emulsion Requirements**

Test	HFRS-2P
Viscosity, Saybolt Furol at 122 °F, Seconds	100–400
Sieve Test, Retained on No. 20 Sieve, %	0.10
Demulsibility, 1.2 fl oz 0.02 N, CaCl, %	40+
Residue from Distillation Test to 450 °F	65+
Oil Distillate by Volume of Emulsion, %	3.0-
Tests on Residue from Distillation	
Penetration at 77 °F, 3.5 oz., 5 s, 0.1 mm	90–150
Ductility 39.2 °F, 2 inch/min	20+
Elastic Recovery, % ^a	58+
Float Test at 140 °F, Seconds	1,200+

^aTest in accordance with AASHTO T 301 at a test temperature of 50 °F.

402.2.2.4 Asphalt-Emulsified Prime (AE-P)

The Supplier shall provide AE-P designated asphalt-emulsified prime in accordance with Table 402.2.2.4:1, "Asphalt Emulsified Prime."

**Table 402.2.2.4:1
Asphalt Emulsified Prime**

Test	AE-P
Viscosity Saybolt Furol at 122 °F, Seconds	15–150
Settlement 24 h, %	1-
Residue from Distillation Test, %	65+
Oil Distillate by volume of Emulsion, %	25-
Tests on Residue from Distillation	
Solubility in Trichloroethylene, %	97.5+

402.2.2.5 Penetrating Emulsified Prime (PE-P)

The Supplier shall provide PE-P designated penetrating emulsified prime in accordance with Table 402.2.2.5:1, "Penetrating Emulsified Prime."

**Table 402.2.2.5:1
Penetrating Emulsified Prime**

Test	PE-P
Viscosity, Saybolt Furol at 122 °F, Seconds	75-
Sieve Test, Retained on 0.35 in Sieve, %	0.1-
Residue from Distillation Test, %	38+
Oil Distillate by volume of Emulsion, %	0–4

402.2.2.6 Emulsified Petroleum Resin Prime (EPR-1)

The Supplier shall provide EPR-1 designated emulsified petroleum resin prime in accordance with Table 402.2.2.6:1, "Emulsified Petroleum Resin Prime."

**Table 402.2.2.6:1
Emulsified Petroleum Resin Prime**

Test	EPR-1
Particle Charge Test	Positive
Residue from Evaporation Test, % ^a	60+
Sieve Test, Retained on 0.850mm Sieve, % ^b	0.1-
Viscosity, Saybolt Furol at 77 °F, Seconds	14–60

^aASTM D-244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 300°F until foaming ceases, then cool immediately and calculate results.

^bTest procedure with ASTM except that distilled water shall be used in place of two percent (2%) sodium oleate solution.

402.2.2.7 Cutback Asphalts (Medium-Curing Type)

The Contractor shall provide cutback asphalt in accordance with AASHTO M 82. The Contractor shall not use MC-30.

402.2.3 Mineral Admixtures

402.2.3.1 Hydrated Lime

The Supplier shall provide hydrated lime in accordance with ASTM C 1097, with the following exception:

1. Delete ASTM C 1097, section 4.1, and
2. Substitute the following: "Hydrated lime, dry or slurry, will have a maximum of three percent (3%) retained on a No. 30 sieve and a maximum of 25% retained on a No. 200 sieve."

The Supplier shall determine the fineness of hydrated lime in accordance with AASHTO T 219. The Contractor shall use a ¼-pound sample to perform tests in accordance with AASHTO T 219 sections 6.1 and 6.1.1.

402.2.3.2 Anhydrite Based Material

The Supplier shall provide anhydrite based Material in accordance with Tables 402.2.3.2:1, "Anhydrite Based Material Chemical Composition" and Table 402.2.3.2:2, "Anhydrite Based Material Physical Properties." The Contractor shall use ASTM C 114 for the chemical analysis.

**Table 402.2.3.2:1
Anhydrite Based Material Chemical Composition**

Chemical Compound	Percent by Weight
SiO ₂	6.7 to 10.7
Al ₂ O ₃	1.0 to 3.0
Fe ₂ O ₃	1.0 to 1.4
MgO	0.2 to 1.2
CaO	44.5 to 54.5
SO ₃	32.3 to 42.3

**Table 402.2.3.2:2
Anhydrite Based Material Physical Properties**

Property	Range
LOI, %	0.37 to 1.37
Passing #200 Sieve, %	98.8 to 100.0
Passing #325 Sieve, %	98.0 to 100.0
Specific Gravity	2.970 to 3.030

402.2.3.3 Portland Cement

The Contractor shall provide Type I, Type II, or Type I/II Portland Cement in accordance with ASTM C 150.

402.2.3.4 Lubricating Antistrip Additive

Lubricating Antistrip Additive shall be tested and approved by the State Materials Bureau and be on the NMDOT's Approved Product List (APL). The State Materials Bureau will provide Hamburg Wheel Tracking Device and Tensile Strength (AASHTO T-283) testing in order to verify the additive will meet the requirements of an antistrip agent.

402.3 CONSTRUCTION REQUIREMENTS

The Contractor shall submit the Material Supplier's name and address to the Project Manager. If required by the Project Manager, the Contractor shall submit representative samples of each grade or classification of asphalt Materials for testing. The Contractor shall mix and apply asphalt Materials within the approved temperature range.

The Contractor shall not make changes in the crude stock source, manufacture method, or the Supplier without written approval from the Project Manager.

402.4 METHOD OF MEASUREMENT

If asphalt Materials are not stored in tanks for exclusive use on the Project, the Department will determine the Acceptable quantity of Virgin *Asphalt Material*, per lot, based on the following equation:

$$Q = T \times X \tag{1}$$

Where,

- Q* is the quantity of Virgin *Asphalt Material* (in tons)
- T* is the quantity of placed and Accepted asphalt pavement (in tons)
- X* is the average percent virgin asphalt content in the asphalt pavement (per lot)

If mineral admixtures are not stored in silos for exclusive use on the Project, the Department will determine the Acceptable quantity of mineral admixture, per lot, based on the following equation:

$$MA = T \times XMA \tag{1}$$

Where,

- MA* is the quantity of mineral admixture (in tons)
- T* is the quantity of placed and Accepted asphalt pavement (in tons)
- XMA* is the average percent mineral admixture content in the asphalt pavement (per lot)

402.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Virgin Asphalt Material</i>	Ton
<i>Hydrated Lime</i>	Ton
<i>Anhydrite Based Material</i>	Ton
<i>Portland Cement</i>	Ton

402.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Providing and mixing asphalt Materials and mineral admixtures (Hydrated lime, anhydrite based Material, Portland cement, or lubricating antistrip additive);
2. Shipping/Delivery to Project site;

3. Sampling and Testing;
4. Water; and
Application of Asphalt Material onto roadbed.

SECTION 403: OPEN GRADED FRICTION COURSE

403.1 DESCRIPTION

This Work consists of constructing an Open-Graded Friction Course (OGFC), which includes Standard OGFC, Warm Mix Open-Graded Friction Course (WOGFC), or Rubberized Open-Graded Friction Course (ROGFC) on a prepared surface.

403.1.1 Definitions

Open-Graded Friction Course (OGFC) – type of asphalt surface mixture whose function is to provide a free-draining layer that permits surface water to migrate laterally through the mixture to the edge of the pavement.

Warm Mix Open-Graded Friction Course (WOGFC) – OGFC that utilizes a single or combination of Department approved WMA technologies to reduce the production, placement and compaction temperatures of the OGFC mixture.

Rubberized Open-Graded Friction Course (ROGFC) – OGFC that utilizes a Department approved tire rubber modifier (TRM) in the asphalt binder.

403.2 MATERIALS

403.2.1 General

The Contractor shall provide OGFC, WOGFC, or ROGFC composed of aggregate, asphalt binder, and mineral admixture.

403.2.2 Aggregate

The aggregate is crushed stone or crushed gravel, composed of hard durable particles or fragments.

Accepted aggregate Material must meet the following requirements:

1. Have a minimum of 75% two (2) Fractured Faces as determined in accordance with AASHTO T 335, *Fractured Face Determination for Coarse Aggregate*;
2. Be free of organic matter, lumps of clay, or other Material that prevents thorough coating with asphalt binder;
3. Have an Aggregate Index (AI) of 20 or less when determined in accordance with Section 910, "AGGREGATE INDEX;" and
4. The Department will allow the combination of Materials from two (2) or more sources if each source independently meets the requirements of items two (2) and three (3), above.

The Contractor shall ensure the aggregate meets the gradation requirements in Table 403.2.2:1, "OGFC Gradation Requirements," when tested in accordance with AASHTO T 11 and AASHTO T 27. The Department will determine aggregate combined aggregate gradation acceptance by testing samples of the combined aggregates and mineral admixture taken before adding asphalt Materials.

**Table 403.2.2:1
OGFC Gradation Requirements**

Sieve size	% passing
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**Table 403.2.2:1
OGFC Gradation Requirements**

Sieve size	% passing
1/2 inch	100
3/8 inch	90 – 100
No. 4	25 – 55
No. 8	4 – 20
No. 16	0 – 10
No. 50	0 – 6
No. 200	0 – 4

403.2.3 Asphalt Material

The Contractor shall use the binder type and grade as specified in the Contract, in accordance with Section 402, "Asphalt Materials and Mineral Admixture."

403.2.4 Mineral Admixture Material

The Contractor shall provide hydrated lime, Portland cement, or anhydrite based Material in accordance with Section 402, "Asphalt Materials and Mineral Admixture."

403.2.5 Mix Design

The Contractor shall develop the mix design at no additional cost to the Department.

The OGFC, WOGFC, or ROGFC mix design shall be developed in accordance with ASTM D 7064, "Standard Practice for Open Graded Friction Course (OGFC) Mix Design," as modified by the New Mexico Department of Transportation State Asphalt Engineer by a Department-approved testing Laboratory. A list of approved private testing laboratories is available from the State Materials Bureau.

The mix design will establish:

1. A combined gradation (comprised of aggregate and mineral admixture) showing the percent passing each required sieve size that provides a JMF gradation that is within the master range as listed in Table 403.2.2:1, "OGFC Gradation Requirements" for the specified type of OFGC listed in the Contract;
2. A single target asphalt content (a minimum of five and one half percent (5.5%) asphalt Material is required); and
3. A single target mineral admixture content (a minimum of one percent (1%) mineral admixture is required).

The Mix Design shall identify the minimum and maximum mixing and placement temperatures of the mix.

The mix design shall be reviewed by a Professional Engineer licensed by the New Mexico Board of Registration for Professional Engineers and Land Surveyors.

The Contractor shall summarize the mix design results in a format approved by the State Materials Bureau and submit the design and supporting documentation for review and concurrence to the State Asphalt Engineer. Department concurrence of a mix design will not relieve the Contractor of full responsibility of producing an Acceptable mixture.

When Department Reviewed Commercial Mix Designs are used on the Project, the

Contractor shall submit a copy of proposed commercial mix design to the State Asphalt Engineer with the Project information to verify the proposed commercial mix design is appropriate for use and meets all the requirements for the for the specific Project. If the proposed commercial mix design meets all the requirements for the specific Project, the State Materials Bureau may re-issue the proposed commercial mix design as the Project specific mix design for that specific Project.

The State Materials Bureau may allow the Contractor to use a mix design up to one (1) year from the date of review by the State Materials Bureau, based upon the validity of the Aggregate Index. If the Aggregate Index expires before the one (1) year time frame, the review of mix design will expire on the date as indicated on the Summary of Design Sheet and may be renewed by submitting an updated Aggregate Index.

The Contractor may use or re-submit the design before the expiration of the one (1) year period.

The Contractor shall:

1. Not use a Mix Design beyond one (1) year after the State Materials Bureau's review date;
2. Submit Acceptable evidence to the State Materials Bureau verifying that the component Materials have not changed;
3. Submit a new mix design if changing the source of Materials; and
4. Obtain concurrence from the State Materials Bureau before using the new Materials.

403.2.6 Warm Mix Open-Graded Friction Course (WOGFC)

Only Warm Mix (WM) additives or technologies approved by the Product Evaluation Program and currently listed on the Approved Products List (APL) shall be used on Department Projects.

For foamed asphalt systems, water used as directed by the foamed asphalt system manufacturer shall be considered the Warm Mix additive. Only foamed asphalt systems approved by the State Asphalt Engineer shall be used.

To be placed on the APL, the WM additive Supplier shall verify that the asphalt binder with the warm mix additive meets the PG grade of the specified binder listed in the Contract. The potential additive Supplier shall demonstrate this to the Department by evaluating the Asphalt Binder and WM additive for compliance with the rheological properties for low and high temperatures for the specified PG grade in accordance with AASHTO M320, Table 1 and Section 402.2.1.1, "Polymer-Modified Asphalt Binder."

A technical representative of Warm Mix Additive Supplier, including contact information shall be designated in writing via the mix design submittal process. The representative is expected to ensure that the Warm Mix Additive is handled properly. The representative does not have the authority to allow any deviation from the Department Specifications and Project requirements.

Warm Mix additive dosage rates shall not deviate from those designated by the Warm Mix Additive Supplier. If a terminal blend Warm Mix additive is used, the dosage rate shall be shown on the Materials Certificate of Compliance.

The WM Additive supplier and the Asphalt Binder supplier will be consulted when establishing recommend mixing, compaction and maximum allowable temperatures to be used

for the development of the mix design.

Some modification to HMA plants may be necessary to accommodate the WMA technologies.

403.2.7 Rubberized Open-Graded Friction Course (ROGFC)

ROGFC shall be produced with terminal blended asphalt rubber binder.

Terminal blended asphalt rubber binder shall consist of a homogeneous mixture of tire rubber obtained from recycled tires and compatible with PG 70-28+ asphalt binders or as specified in the Contract. All binder components shall be thoroughly blended and reacted prior to use.

The PG 70-28+ asphalt Material or as specified in the Contract for the asphalt rubber binder shall comply with the requirements of Section 402, "Asphalt Materials and Mineral Admixtures" for PG 70-28R+ or as specified in the Contract.

403.3 CONSTRUCTION REQUIREMENTS

403.3.1 General

The Contractor shall use the "strap method" or "meter reading" to determine the quantity of asphalt Material, and maintain the percentage of asphalt Material specified in the mix design in accordance limits shown in Table 403.3.6.2:1, "Acceptance Limits and Factors."

403.3.2 Preparation of Roadbed

Before placing OGFC, WOGFC, or ROGFC the Contractor shall clean Deleterious Materials from the existing surface.

403.3.3 Temperature and Weather Limitations

The Contractor shall:

1. Not place OGFC, WOGFC, or ROGFC on wet surfaces or when the Project Manager determines that the weather conditions prevent proper handling and finishing; and
2. Place OGFC or ROGFC when the Chill Factor is at least 60 °F and 55 °F for WOGFC. If the ambient air temperature is ≥ 90 °F the Chill Factor will not be applied.

403.3.4 Mixing Requirements

The Contractor shall ensure that:

1. Hot mix plants conform to the requirements of Section 423, "Hot-Mix Asphalt (HMA) (Major Paving)" or Section 424, "Warm Mix Asphalt (WMA);"
2. The mineral aggregate is free of deleterious coatings;
3. The moisture content of the combined aggregate and mineral admixture Material is in compliance with the "Combined Aggregate Water Absorption @ SSD" shown on the approved mix design;
4. The aggregate is mixed with asphalt Material until the aggregate particles are thoroughly and uniformly coated;

5. The mixture temperature does not does not exceed the asphalt binder Supplier's recommendation;
6. The placement temperature for the mixture does vary by more than 20 °F from the temperature established on the approved Mix Design, or fall below 220 °F; and
7. Mineral admixture, shall be added to the aggregate in accordance with Section 423, "Hot-Mix Asphalt (HMA) (Major Paving)" or Section 424, "Warm Mix Asphalt (WMA)" within the production tolerances specified in Table 403.3.6.2:1, "Acceptance Limits and Factors."

403.3.5 Placement and Finishing

The Contractor shall:

1. Place the OGFC, WOGFC, or ROGFC with a paving machine in accordance with Section 423.3.4.3, "Pavers;"
2. Roll the surface immediately following OGFC placement with a steel-wheeled, self-propelled roller that weighs enough to achieve adequate consolidation of the aggregate without excessive breakage. The finished surface shall be in accordance with Section 401, "Pavement Smoothness Measurement" and the Pavement Smoothness Category identified in the Contract Plans. For pavements that are not subject to Section 401. "Pavement Smoothness Measurement" the Contractor shall use a ten (10) foot straightedge to ensure the surface is free of irregularities larger than 1/4inch; and
3. Remove low and defective areas immediately, replace them with new OGFC, and compact the corrected Work to conform to the surrounding area.

403.3.5.1 Plan Surfacing Depths

The Contractor shall monitor and record Plan depths throughout the surfacing operations at intervals specified by the Project Manager. The Department will not pay for any excess course depth. Courses will be rejected, if less than 1/2 inch.

403.3.6 Sampling and Testing

403.3.6.1 Contractor Quality Control

After the mix design has been reviewed and issued, the Contractor shall control the mixture production on the project such that the tolerances of Table 403.3.6.2:1 "Acceptance Limits and Factors" are met.

The Contractor shall perform Quality control processes in accordance with Section 902 "Quality Control" and Section 906 "Minimum Testing Requirements."

403.3.6.1.1 Suspension of Operations

If one (1) or more properties listed in Subsection 403.3.6.2, "Department Quality Assurance," fail to meet the Specification requirements for a period of one (1) Day or a maximum production of 1000 tons; the production will be halted by the Project Manager.

The Contractor shall:

1. Use the gradation information to determine causes or factors that may be a contribution to the problem and prepare a plan to solve the problem. Approval of the Plan must be obtained from the Project Manager before resumption of paving operations. Upon approval of the proposed Plan, the Contractor may resume

- operations to determine if the actions taken have corrected the problem;
2. Limit production to 1000 tons that will be tested in 500-ton increments. If that testing indicates that the problem has been corrected, the Contractor may resume full operations. If the problem has not been corrected, reduced production rates and testing as described above will be required; and
 3. Take corrective action to remedy any property of the mix that is out of Specification. Contractors who elect to produce Material that is not within the Specification limits do so at their own risk. Price reductions due to out of Specification Material being placed will be deducted from the unit price of the item in accordance with the Department's current Acceptance and Price Reduction Procedures. All Material that is rejected shall be removed and replaced with Specification Material at the Contractor's expense. Material that is improperly graded or segregated or fails to meet the requirements herein provided shall be corrected or removed and disposed of immediately as directed by the Project Manager at the Contractor's expense.

403.3.6.2 Department Quality Assurance

403.3.6.2.1 Acceptance

The Department will conduct Quality Assurance sampling, testing, and monitoring to ensure that the Contractor provides a mix that meets the tolerances.

Acceptance for gradation will be based on testing of samples obtained from combined aggregates and mineral admixture, before addition of asphaltic Materials. Acceptance for asphalt content will be based on strap method or meter reading. Acceptance for mineral admixture content will be based on daily meter reading totals. The testing will be conducted in accordance Section 906, "Minimum Testing Requirements." Acceptance test results will be provided to the Contractor's Quality Control Representative or designee by the end of the Workday after the samples are taken.

**Table 403.3.6.2:1
Acceptance Limits and Factors**

Characteristic	Specification limits
Asphalt Content	± 0.3% ^a
Mineral Admixture Content	± 0.2% ^a
1/2 inch	100
3/8 inch	90-100
No. 4	25-55
No. 8	4 - 20
No. 16	0-10
No. 50	0-6
No. 200	0-4

^aPercent difference from TV listed on approved JMF.

403.4 METHOD OF MEASUREMENT

403.4.1 OGFC, WOGFC, AND ROGFC

OGFC, WOGFC, AND ROGFC will be measured by the square yard or ton. The average width of the OGFC in place will be used in computing the quantities. The length used in

computing the area shall be station to station along the centerline of the Roadway. All dimensions shall be as shown on the typical section of the Plans.

403.5 BASIS OF PAYMENT

The Accepted quantities of the OGFC, WOGFC, or ROGFC will be paid for at the Contract unit price per square yard or ton.

Pay Item	Pay Unit
<i>Open-Graded Friction Course Complete</i>	Square Yard or Ton
<i>Warm Mix Open-Graded Friction Course Complete</i>	Square Yard or Ton
<i>Rubberized Open-Graded Friction Course Complete</i>	Square Yard or Ton

403.5.1 Price Adjustments

A price reduction in accordance with the Department's Price Reduction Guidelines will be applied if the OGFC, WOGFC, or ROGFC, asphalt Material, or mineral admixture are not produced, mixed, or placed in accordance with the Contract requirements.

403.5.2 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Crushing and stockpiling of Material;
2. Asphalt Material, mineral admixtures, warm mix additives, and tire rubber modifiers;
3. Mix design;
4. Mixing, hauling, placement on a prepared surface; and
5. Process control testing and providing cold feeds.

SECTION 405: DETOUR PAVEMENTS

405.1 DESCRIPTION

This Work consists of the following:

1. Providing and placing surfacing Materials, including Subgrade preparation, Base Course, prime coat, asphalt Material, tack coat, and OGFC, as required in accordance with the Plans;
2. Maintaining, removing, hauling, and disposing of Detour pavements in an environmentally-Acceptable manner; and
3. Hauling and stockpiling salvageable Detour pavements as directed by the Project Manager.

Unless otherwise noted in the Contract, Detour pavements do not include Detour Embankments, drainage, and major Structures. Embankment, drainage, and major Structures will conform to their applicable sections.

405.2 MATERIALS

405.2.1 General

The Contractor shall obtain surfacing Material for the Detour construction from a suitable source in accordance with Section 106, "Control of Materials."

405.2.2 Alternate Pavement Section

Two (2) weeks before constructing the Detour, the Contractor may submit an alternative detour pavement section proposal to the Project Manager for approval. The proposal shall include the surfacing thickness and the types of Materials.

The approved alternate Detour pavement section must have at least the same structural number specified in the Contract.

The Contractor shall determine the structural number in accordance with the values in Table 405.2.2:1, "Structural Coefficients."

**Table 405.2.2:1
Structural Coefficients**

Description	Structural coefficient
Base Course	0.11
Hot-mix asphalt (HMA)	0.44
Cold-mixed asphalt pavement ^a	0.15

^aThe Contractor may use cold-mixed asphalt pavement in low-traffic areas, with the District Construction Engineer's written approval.

405.3 CONSTRUCTION REQUIREMENTS

405.3.1 General

The Contractor shall construct the Detour pavement in accordance with the following applicable Specifications:

1. Section 207, "Subgrade Preparation;"

2. Section 303, "Base Course;"
3. Section 403, "Open Graded Friction Course;"
4. Section 407, "Tack Coat;"
5. Section 408, "Prime Coat;"
6. Section 416, "Minor Paving"
7. Section 423, "Hot Mix Asphalt (HMA) (Major Paving) ;" and
8. Section 424, "Warm Mix Asphalt (WMA)."

405.3.2 Contractor Testing/Design Requirements

The Contractor shall provide Subgrade R-values for the top two (2) ft of the Detour Subgrade by using AASHTO T-190.

405.3.3 Maintenance of Detour Section

The Contractor shall:

1. Ensure the maintenance and repair of the Detours minimizes the impact to the traveling public; and
2. Maintain safe traffic flow during construction.

If the Project Manager determines that the Detour surfacing is damaged, the Contractor shall correct the problem immediately. If the Project Manager determines that the corrective actions failed, overlay the Detour with additional HMA at no additional cost to the Department.

If the Contractor does not immediately fix the Detour surfacing as directed by the Project Manager, the Department will assess damages in accordance with the following Table for each Day that the Detour remains unacceptable to the Project Manager.

**Table 405.3.3:1
Schedule of Damages**

Total Original Contract Amount (\$)	Charge (\$) per Day
≤100,000	500
>100,000-500,000	1,000
>500,000-1,000,000	1,500
>1,000,000-2,000,000	2,000
>2,000,000-4,000,000	2,500
>4,000,000-7,000,000	3,000
>7,000,000-10,000,000	4,000
>10,000,000	5,000

405.3.4 Removal of Detours

When removing the Detour, the Contractor shall dispose of the surfacing Material in an environmentally Acceptable manner, or salvage the Material as shown in the Contract.

The salvage of the Detour pavement Material includes hauling and stockpiling.

405.4 METHOD OF MEASUREMENT

The Department will measure the *Detour Pavement Construction* actually placed and maintained on the top width and length of the detour if paid by the unit of the Contract Item. If no Contract Item exists for *Detour Pavement Construction*, payment will be Incidental to

405.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Detour Pavement Construction</i>	Square Yard

405.5.1 Work Included in Payment

The following Work or items will be considered as included in the payment for Detour Pavement Construction and will not be measured or paid for separately:

1. Submittals;
2. Maintenance of Detours;
3. Furnishing and placement of HMA/WMA, OGFC on Detours;
4. If designated in the Contract; Base Course; Removal of Detour Materials including surfacing, earthwork, and drainage Structures;
5. Furnishing and placement of prime and tack coat;
6. Subgrade preparation;
7. Testing (includes AASHTO T190); and
8. Hauling and stockpiling of salvageable Materials.

SECTION 407: TACK COAT

407.1 DESCRIPTION

This Work consists of providing and applying asphalt Material to an existing HMA, WMA, or portland cement concrete pavement surface.

407.2 MATERIALS

The Contractor shall use one (1) of the following asphalt Materials types for the tack coat:

1. CSS-1, CSS-1H, or SS-1, or SS-1H emulsified asphalt;
2. Performance-graded asphalt binder; or
3. Project Manager approved selection from the Department's *Approved Products List*.

The Contractor shall provide the asphalt Materials in accordance with Section 402, "Asphalt Materials and Mineral Admixtures."

407.3 CONSTRUCTION REQUIREMENTS

The Project Manager will determine the tack coat application rate and as indicated in Section 407.3.4, "Application of Asphalt Materials."

407.3.1 Temperature and Weather Limitations

The Contractor shall:

1. Not apply tack coat on a wet surface.
2. Not apply emulsified asphalt when the air temperature is below the manufacturers recommended application temperature.

407.3.2 Equipment

The Equipment shall include an asphalt distributor and Equipment for heating asphalt Material. The Contractor shall provide Equipment that is in accordance with Section 408, "Prime Coat."

407.3.3 Preparation of Surface

The surfaces and edges to be tack coated shall be dry, patched, cleaned, and free of dirt, surface moisture, vegetation and other Deleterious Materials or irregularities.

407.3.4 Application of Asphalt Material

The Contractor shall:

1. Uniformly apply asphalt Material with a pressure distributor at a rate determined by the Project Manager (to provide a "residual" asphalt cement content of from 0.04 gal per square yard to 0.08 gal per square yard);
2. Ensure that the nozzles on the pressure distributor are fully open and at the same angle from the spray bar, approximately 30°;
3. Keep the spray bar at a height above the pavement surface to provide for a double or triple lap of the applied asphalt Material;
4. Keep traffic off of the tack coat, unless otherwise approved by the Project Manager. If the Roadway being paved is closed to traffic, the Contractor may place tack coat a

maximum of 24 h ahead of the laydown operation. If the Roadway being paved is open to traffic, place the tack coat only over the area that can be paved during that Day's laydown operation. If the Contractor uses an emulsified asphalt tack coat, the Contractor may begin paving operations after the emulsified asphalt is cured.

5. Reapplication of tack coat damaged by traffic or construction Equipment will be at no cost to the Department.

407.4 METHOD OF MEASUREMENT

The Department will consider any water added to further dilute emulsified asphalts incidental to *Asphalt Material for Tack Coat* and no separate payment will be made.

407.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Asphalt Material for Tack Coat</i>	Ton

407.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Providing, mixing, heating, and applying asphalt Materials to the roadbed with an asphalt distributor;
2. Shipping/Delivery to Project site;
3. Sampling and Testing; and
4. Water.

SECTION 408: PRIME COAT

408.1 DESCRIPTION

This Work consists of providing and applying asphalt Material and blotter Material (if required) to an existing surface.

408.2 MATERIALS

The Contractor shall provide one (1) of the following types of prime coat asphalt Material:

1. Asphalt emulsified prime (AE-P);
2. Penetrating emulsified prime (PE-P);
3. Emulsified Petroleum Resin Prime (EPR-1)
4. MC-70; or
5. Other Material approved by the Project Manager.

The Contractor shall provide prime coat asphalt Material in accordance with Section 402, "Asphalt Materials and Mineral Admixtures."

408.2.1 Certification

The Contractor shall provide a manufacturer's written certification that the prime Material is chemically identical to those identified on the Department's *Approved Products List*.

408.2.2 Blotter Material

The Contractor shall provide fine aggregate (sand) blotter Material in accordance with Table 408.2.2:1, "Blotter Material," unless otherwise approved by the Project Manager.

**Table 408.2.2:1
Blotter Material**

Sieve size	% passing
3/8 inch	100
No. 4	80 – 100
No. 16	45 – 80
No. 50	10 – 30
No. 100	2 – 10

408.3 CONSTRUCTION REQUIREMENTS

The Project Manager will determine the prime coat application rate and as indicated in Section 408.3.4, "Application of Prime Material."

408.3.1 Temperature and Weather Limitations

The Contractor shall not apply the prime Material in the following conditions:

1. If the surface has standing water;
2. If the air temperature is less than manufacturer's recommendation; or
3. If weather conditions prevent the proper placement of the prime coat.

The Project Manager may waive these temperature and weather limitations due to wet weather conditions or to protect Work in progress during Department approved suspensions.

408.3.2 Equipment

The Contractor shall:

1. Provide a distributor and Equipment for heating bituminous Material. Ensure the distributor is capable of maintaining the prime Material at an even temperature and can uniformly distribute the Material on variable widths with uniform pressure;
2. Ensure that the distributor can apply the Material as required;
3. Ensure that the distributor circulates the prime Material within the tank, the spray bar, and other accessories when not spraying; and
4. Ensure that the distributor has a hand spray gun with a precise-control single or double nozzle and a positive shut-off valve.

The Contractor shall ensure that the distributor has the following Equipment:

1. A tachometer;
2. Pressure gauges;
3. Accurate volume-measuring devices or a calibrated tank;
4. A thermometer that measures the temperature of tank contents;
5. A power unit for the pump; and
6. Laterally and vertically adjustable spray bars.

408.3.3 Preparation of Surface

The Contractor shall:

1. Shape the surface to be primed in accordance with the Plans, and ensure that it is free of ruts, corrugations, segregated Materials, or other irregularities.
2. Uniformly compact the surface in accordance with Section 303, "Base Course."
3. Ensure that the surface is slightly moist but not saturated when applying the prime.

408.3.4 Application of Prime Material

The Contractor shall:

1. Not apply the prime coat until the Project Manager has approved the quantities, application rates, Material temperature, and locations;
2. The Contractor shall apply the prime Material in a uniform and continuous layer using a pressure distributor;
3. Ensure the nozzles on the pressure distributor are fully open and at the same angle from the spray bar, approximately 30°;
4. Keep the spray bar at a height above the pavement surface to provide a double or triple lap of the prime Material;
5. If using a hand-held want, ensure the application is uniform; and
6. If distribution irregularities occur, cease operations and take corrective action.

If the Department allows traffic on the surface, the Contractor shall maintain one (1)-way traffic on the untreated section of the Roadbed until the treated surface has absorbed the prime Material, then transfer traffic to the treated portion and prime the untreated section.

The Contractor shall perform Work and procedures in accordance with manufacturer's recommendations.

408.3.5 Application of Blotter Material

If the prime Material fails to penetrate the surface within 24 h after its application, the Contractor shall spread blotter Material to absorb the excess Material. The Project Manager may approve the use of blotter Material on Roadway sections that must be opened to traffic before the 24 h waiting period.

408.4 METHOD OF MEASUREMENT

The Department will consider any water added to further dilute emulsified asphalts incidental to *Asphalt Material for Prime Coat* and no separate payment will be made.

408.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Prime Coat Material</i>	Ton

408.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Providing, mixing, heating, and applying asphalt Materials to the roadbed with an asphalt distributor;
2. Provide blotter Material as required;
3. Shipping/Delivery to Project site;
4. Sampling and Testing; and
5. Water.

SECTION 411: HOT-POURED CRACK SEALANT

411.1 DESCRIPTION

This Work consists of preparing and cleaning cracks and joints in the existing Roadway surface and sealing these cracks with hot-poured sealant.

411.2 MATERIALS

For crack and joint seals, the Contractor shall use hot-poured sealant in accordance with the general and physical requirements of ASTM D 6690, as specified in the Contract and shall be on the Departments *Approved Product List* (APL).

The Contractor shall have the Supplier sample and test the sealant in accordance with ASTM D 6690 and provide certified test results for each lot or batch of sealant supplied.

The Contractor shall provide sealant packaged in containers and labeled in accordance with ASTM D 6690. Bulk shipments of sealant must be accompanied by documents that state the following:

1. Manufacturer's name;
2. Trade name of the sealant;
3. Batch or lot number;
4. Pouring temperature; and
5. Safe heating temperature.

The Contractor shall not mix more than one (1) lot or batch within a bulk shipment of sealant.

411.3 CONSTRUCTION REQUIREMENTS

411.3.1 Temperature and Weather Limitations

The Contractor shall apply the sealant in the following conditions:

1. When the air temperature is at least 40 °F and rising; and
2. When the temperature of the existing pavement surface is above 32 °F during application; or
3. As indicated on the manufacturers recommendations.

The Contractor shall not place the sealant during inclement weather, on wet surfaces, or when the wind conditions prevent satisfactory sealing.

411.3.2 Equipment

The Contractor shall:

1. Provide router bits of at least 1/2-inch diameter that cut to one (1) inch deep;
2. Use air compressors that provide uncontaminated air at a pressure capable of cleaning approved cracks; and
3. Equip air compressors with traps to prevent oil and moisture from entering the air stream.

The Equipment for heating and preparing the sealant mixture shall provide a continuous supply of the prepared mixture and maintain a continuous, uniform and homogeneous mixture during the sealing operation. The Contractor shall provide continuous mechanical agitation as necessary to maintain homogeneity.

The Contractor shall use application devices that provide uniform application of the sealant Materials without clogging, or causing other irregularities in distribution. Application devices and Equipment shall meet the requirements of the sealant manufacturer.

411.3.3 Preparation of Cracks

The Contractor shall:

1. Route and clean cracks to the satisfaction of the Project Manager;
2. Route cracks with an average clear opening less than 1/2 inch to provide a minimum sealant reservoir of 1/2 inch wide and to a depth of from 3/4 inch to one (1) inch, unless otherwise directed by the Project Manager. Center routers over the cracks during routing operations;
3. Clean cracks with an average clear opening 1/2 inch or greater with high-velocity compressed air to a depth of from 3/4 inch to one (1) inch, unless otherwise directed by the Project Manager; and
4. Clean loose particles, dust, and other Deleterious Materials, immediately before placing the sealant from the sealant reservoirs with high-velocity compressed air.

411.3.4 Application of Sealant

The Contractor shall:

1. Control the application to confine sealant within the reservoirs;
2. Apply sealant to the clean, dry-surfaced reservoirs to a depth of from 3/8 inch to 1/4 inch below the existing surface of the Roadway. If the Project Manager determines that the method of filling results in an excessive amount of sealant on the pavement surface, stop filling and change the method. Clean excess sealant Material from the pavement surface;
3. Halt operations if application devices clog or irregularities occur during application and take corrective action immediately; and
4. Follow special preparation or placement requirements indicated by the manufacturer.

411.3.5 Resumption of Traffic

The Contractor shall cure sealant in accordance with the manufacturer's requirements, before placing traffic on the pavement surface.

411.4 METHOD OF MEASUREMENT

The Department will verify the measured quantity with the Contractor daily.

411.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Hot-Poured Crack Sealing</i>	Pound

411.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Prepare, clean, and fill cracks and joints with hot-poured sealant on the existing Roadway.

SECTION 412: HOT IN-PLACE RECYCLING OF ASPHALT PAVEMENT (REMIXING METHOD)

412.1 DESCRIPTION

This Work consists of recycling the existing in-place asphalt surface in a multi-step process of cleaning, heating, milling, rejuvenating (if required), spreading, and leveling. This Work also consists of placing and compacting the new HMA/WMA over the recycled surface. The Contract may require the Contractor to blend recycled Material with an asphalt-rejuvenating agent.

412.2 MATERIALS

412.2.1 Rejuvenating Agent

The Contractor shall provide an agent that will rejuvenate the existing Roadway's binder properties. The existing Roadway's asphalt Material shall be extracted, recovered, and combined with a virgin asphalt binder per AASHTO M 323, Appendix A such that the combination of the rejuvenating agent with the existing Roadway asphalt binder will meet the full AASHTO M 320 requirements for the required PG asphalt grade in the approved mix design.

412.2.2 HMA/WMA

The Contractor shall provide the HMA Material and mix design in accordance with Section 416, "Minor Paving;" Section 423, "Hot-Mix Asphalt (HMA) (Major Paving);" or Section 424, "Warm Mix Asphalt (WMA)."

412.3 CONSTRUCTION REQUIREMENTS

412.3.1 Equipment

412.3.1.1 General

At the Pre-Construction Conference, the Contractor shall:

1. Notify the Project Manager of the necessary types of Equipment;
2. Deliver the Equipment to the Project in time for the Project Manager's evaluation;
3. Demonstrate the rate, depth, and recycling operations on a Roadway test section before beginning production operations; and
4. Submit a Quality Control Plan in accordance with the most recent Department's Contractor Quality Control Guidelines for the Project Manager's approval.

If Equipment or recycling operations do not meet requirements, the Contractor shall correct or replace the deficiency.

412.3.1.2 Heating Units

The Contractor shall ensure the heating units can heat the existing asphalt pavement high enough to mill the Material to the minimum specified depth without the following results:

1. Breaking aggregate particles;
2. Charring the existing asphalt; or
3. Producing undesirable pollutants.

The Contractor shall apply the heat under an enclosed or shielded hood. The Contractor shall not heat the pavement surface with a direct flame.

412.3.1.3 Milling Units

The Contractor shall:

1. Use milling units that can mill to the specified depth;
2. Equip the units with automatic height controls to clear utility manholes and other obstructions in the pavement surface; and
3. Use units with enough power to mill through high spots and create a leveled surface.

412.3.1.4 Rejuvenating Agent Storage Unit

The Contractor shall use a thermostatically-controlled storage unit to maintain the rejuvenating agent at a constant, Supplier-specified temperature.

412.3.1.5 Metering Unit

The Contractor shall:

1. Use a unit that can uniformly apply the rejuvenating agent to the milled Material. The unit shall incorporate a meter for continuous quantity verification;
2. Vary the applied amount in direct proportion to the recycling system's operating speed and synchronize with the amount of Material milled; and
3. Not vary the rejuvenating agent's application tolerance by more than 0.5% of the specified application rate.

412.3.1.6 Blending Unit

The Contractor shall use a twin-shaft pugmill unit that can uniformly mix the milled Material, rejuvenating agent, and virgin HMA/WMA.

412.3.1.7 Spreading and Leveling Unit

The Contractor shall use a unit with automatic grade controls capable of spreading and leveling the Material uniformly over the specified surfaces.

412.3.1.8 Compaction Equipment

The Contractor shall use compaction Equipment in accordance with Section 423.3.4.4, "Compaction Equipment."

412.3.2 Construction Details

412.3.2.1 Cleaning of Existing Pavement Surface

Before beginning hot in-place recycling, the Contractor shall clean the existing pavement surface of non-asphalt Materials by blading and brooming or use methods approved by the Project Manager.

412.3.2.2 Heating, Milling, and Processing

The Contractor shall heat, mill, and process the in-place asphalt surface in a uniform manner to the widths and depths in accordance with the Plans. The Contractor shall control the heat to assure a uniform heat penetration without the following results:

1. Differential softening of the pavement;
2. Breaking of the aggregate particles;
3. Charring of the asphalt; or
4. Producing undesirable pollutants.

If required, the Contractor shall:

1. Uniformly apply the rejuvenating agent to the milled Material before the addition of new HMA or WMA;
2. Determine the actual amount of rejuvenating agent needed to address field conditions and to optimize the properties of the in-place pavement; and
3. Uniformly mix the milled Material, rejuvenating agent, and HMA or WMA to produce a homogeneous mixture.

412.3.2.3 Placing and Compacting

The Contractor shall uniformly spread and level the recycled mixture to the width, grade, and slope specified in the Plans. Immediately after leveling the recycled Material, compact the Material in accordance with Section 423.3.5, "Placement Operations."

412.3.2.4 Temperature Requirements

The Contractor shall ensure the temperature of the asphalt Materials immediately behind the laydown machine is between 225 °F and 300 °F.

412.3.2.5 Joints

The heating unit shall heat a minimum of four (4) inches beyond the width of recycling. The Contractor shall construct joints in accordance with Section 423.3.5.4, "Joints."

412.3.2.6 Debris and Waste Material Disposal

The Contractor shall dispose of debris and waste Material in an environmentally safe manner at locations approved by the Project Manager.

412.3.2.7 Weather Limitations

The Contractor shall not perform hot in-place recycling of asphalt pavement when the Roadway surface is wet or when weather conditions prevent the proper handling, finishing, and compacting of the asphalt mixture.

412.3.2.8 Surface Tolerance

The Contractor shall provide a compacted surface in accordance with Section 423.3.5.5, "Surface Tolerances."

412.3.2.9 Plan Surfacing Depths

The Contractor shall monitor and record the depth of the compacted recycled pavement Material (including new HMA Material, if specified) during the placement operations. The

Contractor shall perform this task in accordance with the Department's *Minimum Testing and Acceptance Requirements* and as approved by the Project Manager. The Project Manager will address deficiencies of more than 0.5 inches by:

1. Accepting the in-place compacted thickness at an adjusted price; or
2. Rejecting the in-place mixed Material and requiring the Contractor to remove and replace.

412.3.3 Contractor Quality Control

412.3.3.1 Contractor Quality Control for Materials

The Contractor shall provide new HMA or WMA Materials in accordance with Section 423.3.6.1, "Contractor Quality Control;" except take random test samples from the HMA/WMA windrow before the Material goes through the paver.

412.3.3.2 Contractor Quality Control for Compaction

See Section 423.3.6.1.2, "Contractor Quality Control for Compaction."

412.3.3.3 Suspension of Operations

See Section 423.3.6.3, "Acceptance."

412.3.3.4 Project Verification Testing

The Contractor shall place new HMA Materials in accordance with Section 423.3.6.4, "Independent Assurance Testing" or WMA Materials in accordance with Section 424.3.6.4, "Independent Assurance Testing."

412.3.4 Department Quality Assurance

412.3.4.1 Department Quality Assurance Testing for HMA Mix

New HMA Materials shall meet the requirements of Section 423.3.6, "Sampling and Testing," with the exception that the Department will base Acceptance on random test samples taken from the HMA windrow before the Material goes through the paver. New WMA Materials shall meet the requirements of Section 424.3.6, "Sampling and Testing," with the exception that the Department will base Acceptance on random test samples taken from the WMA windrow before the Material goes through the paver.

412.3.4.2 Department Quality Assurance Testing for HMA or WMA Compaction

The Department will test in accordance with Section 423.3.6, "Sampling and Testing" or 424.3.6, "Sampling and Testing." The target density is a mean density of at least 93% of the theoretical maximum density. The Project Manager will grant an exception to the target if the Contractor can demonstrate that the target density is not reasonably obtainable because of the conditions of the existing Pavement Structure or Subgrade Materials.

If the Department grants this exception, the Contractor shall construct a Roadway test strip and develop a HMA compaction process to obtain the highest possible target density based on an approved roller's density gain per pass, in accordance with Section 423.3.4.4, "Compaction Equipment." The Contractor shall not begin paving operations (except for the Roadway test strip) until the Project Manager approves the process. The in-place density shall not exceed 98% of the theoretical maximum density or be more than three percent (3%)

below the target density. If a lot's mean density does not meet this density requirement, the Project Manager may do the following:

1. Require the Contractor to remove and replace the defective lot of HMA or WMA at no additional cost to the Department; or
2. Accept the HMA or WMA Material and pay the Contractor 50% of the Bid Item Unit Price.

If the Project Manager determines that the mean measured densities are consistently higher, not exceeding 93% of the theoretical maximum density, or lower than the current lot's target density, the Project Manager may establish a new Acceptance lot on the Project.

412.3.4.3 Department Quality Assurance Testing for HMA/WMA Smoothness

If the Contract requires two (2) or more layers of new HMA/WMA Material, place in accordance with Section 401, "Pavement Smoothness Measurement." For the purposes of this section, Hot Recycled Insitu Material is not defined as HMA/WMA.

412.4 METHOD OF MEASUREMENT

The Department will measure HMA in accordance with Section 423.4, "Method of Measurement" or WMA in accordance with Section 424.3, "Method of Measurement."

412.5 BASIS OF PAYMENT

The Department will pay for new HMA Material in accordance with Section 423.5, "Basis of Payment" or WMA Material in accordance with Section 424.5, "Basis of Payment."

Pay Item	Pay Unit
<i>Hot In-place Recycling of Asphalt Pavement</i>	Square Yard
<i>Rejuvenating Agent</i>	Gallon

412.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Recycling existing in-place asphalt surface in a multi-step process of cleaning, heating, milling, and rejuvenating (if required), spreading and leveling;
2. Placing and compacting new HMA/WMA over recycled surface;
3. Shipping/Delivery of new HMA/WMA to Project site; and
4. Development of the Contractor Quality Control Plan in accordance with Section 902, "Quality Control."

SECTION 413: SINGLE-MACHINE HOT IN-PLACE SURFACE REPAVING

413.1 DESCRIPTION

This Work consists of recycling the existing asphalt surface in a simultaneous multi-step process of cleaning, heating, milling, scarifying, rejuvenating (if required), spreading, and leveling. This Work also consists of placing and compacting new HMA or WMA Material over the recycled surface. The Contract may require the Contractor to blend the recycled Material with an asphalt-rejuvenating agent.

413.2 MATERIALS

413.2.1 Rejuvenating Agent

The Contractor shall provide an agent that will rejuvenate the existing Roadway binder properties. The Contractor shall extract, recover, and combine the existing Roadway's asphalt Material with a virgin asphalt binder per AASHTO M 323, Appendix A, such that the combination of the rejuvenating agent with the existing Roadway asphalt binder will meet the AASHTO M 320 requirements for the required PG asphalt grade in the approved mix design.

413.2.2 HMA

The Contractor shall provide HMA Material in accordance with Section 416 "Minor Paving", Section 423, "HOT MIX ASPHALT (HMA) (MAJOR PAVING)", or WMA Material in accordance with Section 424, "Warm Mix Asphalt (WMA)."

The Contractor shall provide a HMA mix design in accordance with Subsection 423.2, "Materials" or a WMA mix design in accordance with Subsection 424.2, "Materials." The State Materials Bureau must approve the HMA or WMA mix design before the beginning of the Work.

413.3 CONSTRUCTION REQUIREMENTS

413.3.1 Equipment

413.3.1.1 General

At the Pre-Construction Conference, the Contractor shall:

1. Notify the Project Manager of the type of Equipment that will be used;
2. Deliver the Equipment to the Project in time for the Project Manager's evaluation;
3. Submit a Quality Control Plan in accordance with the most recent Department's Contractor Quality Control Guidelines for the Project Manager's approval;
4. Provide a machine with a single, self-propelled mobile unit capable of heating, scarifying, rejuvenating, mixing, leveling the existing surface Material, and immediately laying new hot-mix Material over the recycled surface;
5. Demonstrate the rate, depth, and recycling capabilities on the Roadway before beginning operations; and
6. Correct or replace any deficiency, if the Equipment or recycling operations do not meet requirements.

413.3.1.2 Heating Unit

The Contractor shall use a height-adjustable heating unit that is specifically designed to heat the upper layer of asphalt pavement. The unit shall heat the asphalt pavement in a manner that:

1. Will not burn, char, coke, or scrub the recycled mix;
2. Will meet State and local air quality requirements;
3. Will not pose health risks or damage to property;
4. Will not break aggregate particles; and
5. Will produce enough heat to soften the pavement to at least a depth of one (1) inch.

The Contractor shall apply the heat under an enclosed or shielded hood so that blasting or scrubbing of the existing pavement is eliminated. The Contractor shall use Equipment that can apply heat uniformly under controlled atmospheric conditions to eliminate free oxygen under the heating chamber.

413.3.1.3 Milling/Scarifying Unit

The Contractor shall use a unit that can remove pavement to a minimum depth of one (1) inch. The unit shall loosen the in-place asphalt pavement to a minimum depth of one (1) inch without excessively breaking the aggregate. The Contractor shall use a unit equipped with automatic height, grade, and cross slope controls with enough power to push the scarifiers through the high spots and create a leveled surface.

413.3.1.4 Rejuvenating Agent Storage Unit

The Contractor shall use a thermostatically-controlled storage unit to maintain the rejuvenating agent at a constant, Supplier-specified temperature.

413.3.1.5 Metering Unit

The Contractor shall:

1. Use a unit that can uniformly apply the rejuvenating agent to the milled and scarified Material. The unit shall incorporate a meter for continuous quantity verification;
2. Vary the applied amount in direct proportion to the recycling system's operating speed and synchronize with the amount of Material milled or scarified; and
3. Not vary the rejuvenating agent's application rate by more than +/- 0.5% of the rate defined in the mix design.

413.3.1.6 Blending Unit

The Contractor shall use a unit that can mix the scarified Material with the rejuvenating agent to produce a uniform, consistent final product.

413.3.1.7 Spreading and Leveling Unit

The Contractor shall:

1. Use a unit equipped with automatic grade controls, capable of uniformly spreading and leveling the blended recycled Material;
2. Use a unit equipped with a leveling blade and auger capable of moving recycled Material in a transverse direction to the center of the windrow;
3. Equip the unit with a recycling screed to partially compact the recycled mix before placing the top layer of new HMA or WMA; and

4. Coordinate the repaver speed with the production of the HMA or WMA plant to achieve a continuous operation.

413.3.1.8 Compaction Equipment

The Contractor shall use Equipment in accordance with Section 423.3.4, "Equipment."

413.3.2 Construction Details

413.3.2.1 Cleaning of Existing Pavement Surface

Before beginning hot in-place recycling, the Contractor shall clean the existing pavement surface of non-asphalt Materials by blading and brooming or other methods approved by the Project Manager.

413.3.2.2 Heating, Milling/Scarifying, and Processing

The Contractor shall:

1. Evenly heat, mill, scarify, and rework the in-place asphalt surface to a minimum depth of one (1) inch, in accordance with the Plans;
2. Heat the existing pavement surface with continuously moving heaters to scarify the pavement to at least a one (1) inch average depth in a single pass;
3. Keep the surface temperature of the remaining in-place pavement below 475 °F and produce reclaimed mix at a temperature of at least 225 °F;
4. Extend the heating operation at least four (4) inches beyond the width of scarification on both sides;
5. Immediately scarify the heated pavement with scarifying shanks spaced so that they cover the surface without leaving ridges;
6. Mount the shanks to allow control from the operator's platform; and
7. Scarify and cut through the pavement at a level that comes within 1/4 inch of the finished pavement's grade and cross slope.

If required, the Contractor shall uniformly apply the rejuvenating agent to the Material immediately after milling and scarifying.

413.3.2.3 Placing and Compacting

The Contractor shall:

1. Uniformly spread and level the recycled mixture to the width, finished grade, and cross slope, shown in the Contract;
2. Place a new layer of HMA or WMA on top of the recycled paving material using a four (4)-section vibratory screed after partially compacting the recycled mixture with the recycling screed;
3. Perform this in one (1) continuous operation while the temperature of the recycled mix is at least 225 °F; and
4. Compact the Material in accordance with Section 423.3.5, "Placement Operations."

413.3.2.4 Temperature Requirements

The Contractor shall maintain the temperature of the asphalt Material between 225 °F and 300 °F when measured immediately behind the laydown machine.

413.3.2.5 Joints

The heating unit shall heat a minimum of four (4) inches beyond the width of recycling. The Contractor shall construct joints in accordance with Section 423.3.5.4, "Joints."

413.3.2.6 Debris and Waste Material Disposal

The Contractor shall dispose of debris and waste material in an environmentally safe manner at locations approved by the Project Manager.

413.3.2.7 Weather Limitations

The Contractor shall not perform hot in-place recycling of asphalt pavement when the Roadway surface is wet or when weather conditions prevent the proper handling, finishing, and compacting of the asphalt mixture.

413.3.2.8 Surface Tolerance

The Contractor shall place the compacted surface of recycled pavement material or new HMA Material in accordance with Section 423.3.5.5, "Surface Tolerances."

413.3.2.9 Plan Surfacing Depths

The Contractor shall monitor and record the Material depth of the compacted recycled pavement Material or new HMA or WMA Material throughout the placement operations. The Contractor shall perform this task in accordance with the Department's *Minimum Testing and Acceptance Requirements* and as approved by the Project Manager. The Project Manager will address a deficiency of more than 0.5 inches in-place compacted thickness as follows:

1. Accept the in-place compacted thickness at a reduced payment; or
2. Reject the in-place mixed Material.

413.3.3 Contractor Quality Control

413.3.3.1 Contractor Quality Control for Materials

The Contractor shall place new HMA Materials in accordance with Section 423.3.6.1, "Contractor Quality Control" or WMA Materials in accordance with Section 424.3.6.1, "Contractor Quality Control," except take random test samples from the HMA or WMA windrow before the Material goes through the paver.

413.3.3.2 Contractor Quality Control for Compaction

See Section 423.3.6.1.2, "Contractor Quality Control for Compaction."

413.3.3.4 Project Verification Testing

New HMA Material is subject to Independent Assurance Testing in accordance with Section 423.3.6.4, "Independent Assurance Testing." New WMA Material is subject to Independent Assurance Testing in accordance with Section 424.3.6.4, "Independent Assurance Testing."

413.3.4 Department Quality Assurance

413.3.4.1 Department Quality Assurance for HMA

New HMA Materials shall meet the requirements of Section 423.3.6.2.1, "Acceptance," and new WMA Materials shall meet the requirements of Section 424.3.6.2.1, "Acceptance," with the exception that the Department will base Acceptance on random test samples taken from the HMA or WMA before the Material goes through the paver.

413.3.4.2 Department Quality Assurance Testing for HMA Compaction

The Contractor shall meet the requirements of Section 423.3.6.2.1 "Acceptance" or Section 424.3.6.2.1, "Acceptance." The Project Manager will grant an exception to the mean density requirement of at least 93% of the theoretical maximum density if the Contractor can demonstrate that a minimum of 93% cannot be reasonably obtained because of the conditions of the existing Pavement Structure or Subgrade Materials. If the Project Manager grants this exemption, the Contractor shall construct a Roadway test strip and develop a HMA or WMA compaction process to get the highest possible density based on an approved roller's density gain per pass, in accordance with Section 423.3.4.4, "Compaction Equipment." The Project Manager will approve the process (except for the Roadway test strip) before paving operations begin. In no case shall the percentage of theoretical maximum density exceed 98% nor fall more than three (3) percentage points lower than the target density. If a lot does not meet either of these density requirements, the Project Manager will do the following:

1. Accept and pay for the lot of HMA or WMA Material at 50% of the Bid Item Unit Price; or
2. Reject the in-place Material and require the Contractor to remove and replace.

If the Project Manager determines that the mean measured densities are consistently higher, but not to exceed 93%, or lower than the current lot's target density, the Project Manager may establish a new Acceptance lot on the Project.

413.3.4.3 Department Quality Assurance Testing for HMA/WMA Smoothness

If the Contract requires two (2) or more lifts of new HMA/WMA Material, place in accordance with Section 401, "Pavement Smoothness Measurement." For the purposes of this section, Hot Recycled Insitu Material is not defined as HMA.

413.4 METHOD OF MEASUREMENT

If the Contract requires HMA, the Department will measure it in accordance with Section 423.4, "Method of Measurement."

413.5 BASIS OF PAYMENT

The Department will pay for new HMA Material in accordance with Section 423.5, "Basis of Payment."

Pay Item	Pay Unit
<i>Single-Machine Hot In-Place Surface Repaving</i>	Square Yard
<i>HMA or WMA Sampling and Testing by the Contractor</i>	Lump Sum
<i>Rejuvenating Agent</i>	Gallon

413.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Recycling existing in-place asphalt surface in a multi-step process of cleaning, heating, milling, and rejuvenating (if required), spreading and leveling;
2. Placing and compacting new HMA/WMA over recycled surface;
3. Shipping/Delivery of new HMA/WMA to Project site; and
4. Development of the Contractor Quality Control Plan in accordance with Section 902, "Quality Control."

SECTION 414: COLD MILLING

414.1 DESCRIPTION

This Work consists of cold milling pavement surfaces and removing, hauling, and disposing of cold-milled Materials.

414.2 MATERIALS—Reserved

414.3 CONSTRUCTION REQUIREMENTS

414.3.1 Equipment

The Contractor shall use a cold milling machine that accurately controls the cross section depth and cross-slope within a 1/4 inch tolerance, unless otherwise shown in the Contract. The Equipment must control cross section grade by using an independent grade control or a 40 ft minimum external reference.

The Contractor shall use Equipment that provides an enclosed cutting area and dust control.

The milling Equipment must produce a uniform milled surface. The Contractor shall maintain the Equipment's teeth and spacing to produce the desired texture. The Contractor shall immediately replace broken, damaged, or excessively worn teeth.

414.3.2 Operations

The Contractor shall cold mill the existing pavement surface in accordance with the Contract.

The Contractor shall adjust the specified depth in maximum increments of 1/4 inch, as directed by the Project Manager. The Contractor shall minimize gouges, grooves, and ridges to create a uniform surface without deviations greater than 1/2 inch when measured with a ten (10) ft straightedge. The Contractor shall keep the milled surface free of loose Material. The Contractor shall remove the cold milled pavement Material and dispose of the surfacing Material in an environmentally Acceptable manner or stockpile in accordance with the Contract.

The Contractor shall perform milling operations adjacent to the traveled lanes in accordance with the Department's Administrative Directive (AD) – 241, "Drop off Guidelines" current at time of bid. The Contractor shall not expose the milled surface to traffic for more than 48 hours before beginning further surface operations unless otherwise specified in the Contract. The Contractor shall remove any standing water.

The Contractor shall correct unacceptable Work and damage to adjacent Structures caused by the operations and obtain Project Manager's approval of corrected Work. Repair damage to the milled surface, as directed by the Project Manager. If the Project Manager determines that damage is due to conditions beyond the Contractor's control, the Department will pay for correcting the damage as Extra Work.

The Contractor may use cold milled pavement Material as RAP or recycled concrete (RC) in accordance with the Contract.

414.4 METHOD OF MEASUREMENT

The Department will measure cold milling to the nearest 1/4 inch, if by the square yard-inch.

414.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Cold Milling (Asphalt)</i>	Square Yard-Inch or Square Yard
<i>Cold Milling (Concrete)</i>	Square Yard-Inch or Square Yard
<i>Patching of Milled Surface</i>	Ton

414.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Water (hauling, supplying etc.);
2. Hauling & Stockpiling cold millings at Contract designated locations:
 - a. Cross-sections shall be performed and sealed by a licensed NM Professional Surveyor of designated locations and provided to the Project Manager;
3. Debris cleaning & sweeping;
4. Disposal of cold millings not to be retained by the Department;
5. Dispose of removed asphalt pavement Materials, not including minor sweepings, belonging to the Department using one (1) or more of the following methods:
 - a. Recycling and mixing it into Base Course, Subgrade or HMA of the new Roadway, with approval of the Project Manager;
 - b. Break down asphalt surfacing removed from the Project to a nominal two (2) inch size, or smaller, haul and stockpile the Material at a location approved by the Project Manager or as indicated in the Plans; or
 - c. If the Material is to be permanently placed within the Shoulder or Median, it shall be treated by using one (1) of the following methods:
 - i. Machine-compacted; or
 - ii. Sealed with an approved rejuvenating agent.

SECTION 415: PAVEMENT SURFACE RESTORATION

415.1 DESCRIPTION

415.1.1 General

This Specification covers the requirements for:

1. **Option A:** In-Situ Cold Recycling of Existing Surfacing; and
2. **Option B:** Cold Milling with Hot-Mix Asphalt (HMA) or Warm Mix Asphalt (WMA) Inlay.

Choose either option. The Contractor may change options once during the Project at no additional cost to the Department.

415.1.2 Option A: In-Situ Cold Recycling of Existing Surfacing

This Work consists of the following:

1. Pulverizing the existing surfacing;
2. Mixing an emulsified binder agent with the pulverized surfacing;
3. Mixing hot hydrated lime slurry with the pulverized surfacing;
4. Spreading and compacting the mixture; and
5. Sealing the compacted surface.

415.1.3 Option B: Cold Mill with HMA Inlay

This Work consists of the following:

1. Cold milling;
2. Applying a tack coat; and
3. Placing an inlay of HMA or WMA.

415.2 MATERIALS

415.2.1 Option A: In-Situ Cold Recycling of Existing Surfacing

The Contractor shall:

1. Use an emulsified binder agent that is polymerized high-float emulsion HFE-150P, unless otherwise specified. Changing one (1) grade up or down will change the Bid Item Unit Price based on the difference in invoice prices between the grades of emulsion;
2. Change the grade only with the approval of the Project Manager and District Laboratory supervisor;
3. Use polymerized high-float emulsion in accordance with Section 402, "Asphalt Materials and Mineral Admixtures;" and
4. Use cold recycled Material that meets the following gradation requirements:

**Table 415.2.1:1
Cold Recycled Pavement Gradation Requirements**

Sieve size	% passing
1 1/4 inch ^a	100
One (1) inch	90-100

**Table 415.2.1:1
Cold Recycled Pavement Gradation Requirements**

Sieve size	% passing
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^aAllow 1 1/2 inch if pavement with fabric is recycled.

The Contractor shall use sealing emulsion that is diluted high-float emulsion, CSS-1, or another approved equal.

The Contractor shall use hot hydrated lime slurry meeting the following requirements:

1. High-calcium pebble quicklime meeting the requirements of ASTM C 977;
2. Clean water in accordance with Section 509.2.6, "Water;" and
3. Slurry with a minimum dry solids content of 35% by weight and consisting of a uniform, pumpable suspension of solids in water.

415.2.1.1 Option A Mix Design

The Contractor shall:

1. Provide a Laboratory mix design developed and tested in accordance with the Department's procedures. The mix design will establish the initial target addition rate for the emulsified binder agent and for the hot hydrated lime slurry;
2. Provide copies of the Laboratory mix design, along with supporting documentation, to the Project Manager, the District Laboratory supervisor, and the State Materials Bureau; and
3. Not use the mix design without State Materials Bureau approval. The Department will consider the Laboratory mix design a starting point only. The Contractor may adjust the target addition rates for emulsified binder agent and hot hydrated lime slurry as necessary, with the Project Manager's approval.

415.2.2 Option B: Cold Mill with HMA Inlay

Cold millings removed during the surface restoration process will become the property of the Department, unless used on the Project or otherwise specified. The Contractor may use cold milling Material from this Project as RAP in the HMA or WMA inlay.

The Contractor shall:

1. Provide HMA or WMA in accordance with a Department-recognized HMA/WMA mixture type, with a nominal size of at least 3/4 inch or greater, and Section 423, "HOT MIX ASPHALT (HMA) (MAJOR PAVING) or Section 424, "WARM MIX ASPHALT (WMA);" and
2. Use a tack coat in accordance with Section 407, "Tack Coat." The Contractor shall use HMA mixture containing performance-graded asphalt Material in accordance with Section 402, "Asphalt Materials and Mineral Admixtures."

415.2.2.1 Option B Mix Design

The Contractor shall provide a mix design developed and approved in accordance with Section 423, "HOT MIX ASPHALT (HMA) (MAJOR PAVING) or Section 424, "WARM MIX ASPHALT (WMA)."

415.2.3 Equipment

415.2.3.1 Option A: In-Situ Cold Recycling of Existing Surfacing

415.2.3.1.1 Cold In-Situ Machinery

The Contractor shall:

1. Use a self-propelled machine capable of pulverizing in-situ asphalt Materials to the specified depth in one (1) pass;
2. Ensure that the machine provides a minimum rotor cutting width of 12 ft with automatic grade and slope control;
3. Use machine with screening and crushing capabilities to reduce or remove oversized particles before mixing with emulsion. The Department will allow the removal of a maximum of two percent (2%) oversize Material before adding emulsion, with the Project Manager's approval;
4. Use a mixing machine capable of mixing the pulverized Material and the emulsified binder agent in a homogeneous mixture and placing in a windrow while preventing segregation;
5. Use a positive displacement pump capable of accurately metering the required quantity of emulsified binder agent into the pulverized Material;
6. Equip the pump with a positive interlock system that will permit addition of the emulsified binder agent only when the pulverized Material is present in the mixing chamber, and that will automatically shut off when the Material is not in the mixing chamber;
7. Equip each mixing machine with a meter capable of registering the rate of flow and total delivery of the emulsified binder agent introduced into the mixture; and
8. Calibrate the meter in the presence of the Project Manager before beginning recycling operations and check or calibrate the meter as directed by the Project Manager.

415.2.3.1.2 Lime Slurry Equipment

The Contractor shall:

1. Produce lime slurry at the job site using a batch type process;
2. Ensure the Equipment accurately proportions the quicklime and water, mixes the two (2) to obtain proper slaking, and maintains homogeneous slurry;
3. Provide horizontal mixing shafts in the transports used to convey the slurry to maintain a homogenous mixture;
4. Add the lime slurry to the pulverized surfacing with a spray bar located at the cutting head on the milling machine; and
5. Use a metering device that accurately measures the amount of slurry delivered to within \pm ten percent (10%) by weight.

415.2.3.1.3 Pavers

The Contractor shall:

1. Place the recycled asphalt Base Course with a self-propelled asphalt paver in accordance with Section 423.3.4.3, "Pavers," except do not heat the screed; and
2. Use Equipment capable of spreading the recycled asphalt base in one (1) continuous pass, without segregation, to the section shown on the Plans.

When using a pick-up machine to feed the windrow into the paver's hopper, the Contractor shall ensure that it is capable of picking up the entire windrow, down to the underlying Materials.

415.2.3.1.4 Rollers

The Contractor shall:

1. Provide rollers in accordance with Section 423.3.4.4, "Compaction Equipment;"
2. Ensure that the number, weight, and types of rollers are sufficient to obtain the required compaction while the mixture is in a workable condition;
3. Use a pneumatic roller that weighs at least 30 ton for the breakdown roller; and
4. Equip rollers with pads and water systems that prevent the recycled mixture from sticking to the roller wheels.

415.2.3.1.5 Brooms

The Contractor shall maintain a working rotary power broom on site capable of removing aggregate that dislodges from the recycled surface.

415.2.3.2 Option B: Cold Mill with HMA or WMA Inlay

The Contractor shall provide and use Equipment in accordance with Section 423, "HOT MIX ASPHALT (HMA) (MAJOR PAVING)," Section 424, "WARM MIX ASPHALT (WMA)," Section 407, "Tack Coat," and Section 414, "Cold Milling."

415.3 CONSTRUCTION REQUIREMENTS

Before beginning the Pre-Paving Conference, the Contractor shall:

1. Submit a paving schedule to the Project Manager for pavement surface restoration operations (Option A or Option B);
2. Begin paving operations only after the Project Manager has given written approval; and
3. Monitor and record Plan depths throughout the pavement surface restoration operations and at intervals directed by the Project Manager. The Department will not pay for any depth in excess of the Contract-specified depth.

415.3.1 Option A: In-Situ Cold Recycling of Existing Surfacing

The Contractor shall ensure that Option A Work has a minimum depth of four (4) inches and the specified width, or as directed by the Project Manager. The Contractor shall begin placing the HMA or WMA overlay of the in-situ cold recycled layer within one (1) week of completing the in-situ cold recycled layer.

The Contractor shall:

1. Remove Deleterious Materials within the width of the pavement to be recycled before beginning recycling operations or other relevant Work;
2. Dispose of the debris as directed by the Project Manager;
3. Control water to the pulverized Material to facilitate uniform mixing with the emulsified binder agent;
4. Add water before or with the emulsified binder agent;

5. Provide a means to accurately meter and register the rate of flow of water into the pulverized Material;
6. Begin the initial pass of the milling Equipment at the lowest portion of the section and proceed in succession towards the higher side of the slope, if the typical section to be recycled is on a super elevated or sloped section;
7. Remove fillets of fine, pulverized Material that form adjacent to a vertical face before spreading the recycled mix; and
8. Remove fillets adjacent to existing pavement if the Contractor is to remove the fillets by overlapping during subsequent milling operation. If segregation occurs either in the windrow or behind the paver, the Project Manager may require the Contractor to make changes to the Equipment or operations.

If a section of recycled pavement contains a paving fabric, as identified in the Plans, the Contractor shall waste oversized Material as directed by the Project Manager. This may require changes in Equipment and procedures to obtain an Acceptable end product.

The Contractor shall make these changes at no additional cost to the Department.

When a section of recycled pavement contains a paving fabric, not identified in the Plans, or if the vertical location of the fabric varies by more than one (1) inch from that specified, the Contractor shall submit a written proposal to the Project Manager describing in detail the recommendations for addressing the fabric. The Contractor shall address the size of shredded fabric pieces, the removal of oversize fabric pieces, the removal of oversize RAP, and any anticipated changes to the emulsion addition rate.

Proposals that incorporate a reduction of the existing pavement thickness or a decrease in the depth of cold recycling must include an analysis addressing the structural adequacy of the proposed new pavement section. The Contractor shall submit the proposal to the State Materials Bureau for their review. The Contractor shall not begin Work until the Project Manager approves the proposal in writing.

The Contractor shall spread the recycled asphalt base in one (1) continuous pass, without segregation, in accordance with the typical section.

415.3.1.1 Surface Tolerance

The Contractor shall ensure that the final surface of recycled asphalt base does not deviate more than 1/4 inch when measured with a ten (10) ft straightedge.

415.3.1.2 Temperature and Weather Limitations

The Contractor shall not perform recycling operations in the following conditions:

1. The average daily air temperature is below 55 °F;
2. The Chill Factor is below 35 °F;
3. The weather is foggy or rainy; or
4. The weather conditions are such that proper mixing, spreading, and compaction requirements of the recycled Material cannot be accomplished.

415.3.1.3 Binder Application

The Contractor shall apply the emulsified binder agent to the pulverized Material at the target addition rate in accordance with Section 415.2.1.1, "Option A Mix Design." The Contractor shall maintain an allowable tolerance of $\pm 0.2\%$ from the target binder content.

415.3.1.4 Lime Slurry Addition

The Contractor shall add water to the quicklime and incorporate it uniformly into the pulverized surfacing Material at a rate that will result in 1.5% hydrated lime by dry weight of pulverized surfacing Material. The Contractor shall control the addition of lime slurry by continuously weighing the pulverized surfacing Material.

415.3.1.5 Density and Rolling Requirements

The Contractor shall establish a rolling pattern to obtain a minimum of 96% of the maximum theoretical density of a Laboratory briquette, prepared in accordance with Department molding and testing procedures. The Project Manager may require a re-demonstration of rolling capabilities for the following reasons:

1. The Project Manager observes a change in the recycled Materials;
2. The Contractor changes the rolling Equipment; or
3. The Contractor does not obtain proper densities.

The Contractor shall:

1. Perform initial rolling with a pneumatic roller until the mixture has no visible displacement;
2. Perform the final rolling, to eliminate pneumatic tire marks and achieve density, with steel wheel rollers, either in static or vibratory mode;
3. Perform rolling in accordance with Section 423.3.5, "Placement Operations;" and
4. Suspend rolling operations that result in cracking, movement, or other types of pavement damage, and correct the problem. The Project Manager will make suspension and resumption of rolling operations decisions.

415.3.1.6 Finishing Operations

The Contractor shall:

1. Not permit vehicles on the completed recycled asphalt base for at least two (2) hours after the recycled Material is spread and compacted;
2. Slow traffic on the recycled Material when approved by the Project Manager;
3. Allow the recycled Material to cure so that the free moisture in the recycled Material reduces to a maximum of one percent (1%) above the inherent moisture content of the existing pavement by the total weight of the mix; and
4. Determine the inherent moisture content of the existing pavement from samples taken at a maximum of one (1)-mile intervals, or as approved by the Project Manager.

The State will determine the free moisture content of the recycled pavement from samples taken from the same areas and same intervals sampled for the inherent moisture content. The Contractor shall:

1. Take the samples and determine the free moisture immediately before sealing or overlaying operations;

2. Seal the surface with emulsion at an approximate rate of 0.05 gal per square yard to 0.10 gal per square yard, in order to control surface raveling, if the free moisture content of the recycled Materials is on percent (1%) or less above the inherent moisture of the Material;
3. Repair unacceptable recycled Material, as directed by the Project Manager, before placing a subsequent surfacing course;
4. Ensure that the surface of the recycled pavement is safe for traffic; and
5. Remove loose aggregate that develops on the surface of the recycled pavement with a power-broom.

415.3.2 Option B: Cold Mill with HMA or WMA Inlay

The Contractor shall:

1. Ensure that Option B Work has a minimum depth of three (3) inches, unless otherwise specified in the Plans, and a width as specified in the Plans, or as directed by the Project Manager;
2. Mill the pavement surface to the grades, depths, and widths specified in the Plans, if required; and
3. Remove dirt and other objectionable Material from the surface of the pavement with blades, brooms, or other methods approved by the Project Manager in accordance with Section 423, "HOT MIX ASPHALT (HMA) (MAJOR PAVING)," Section 424, "WARM MIX ASPHALT (WMA)" Section 407, "Tack Coat," and Section 414, "Cold Milling."

415.3.3 Contractor Quality Control

415.3.3.1 Contractor Quality Control for Materials

The Contractor shall place new HMA Materials in accordance with Section 423.3.6.1, "Contractor Quality Control" or WMA in accordance with Section 424.3.6.1, "Contractor Quality Control" except take random test samples from the HMA windrow before the Material goes through the paver.

415.3.3.2 Contractor Quality Control for Compaction

See Section 423.3.6.1.2, "Contractor Quality Control for Compaction."

415.3.3.3 Project Verification Testing

The Contractor shall place new HMA Material in accordance with Section 423.3.6.4, "Independent Assurance Testing" or WMA Material in accordance with Section 424.3.6.4, "Independent Assurance Testing."

415.3.4 Department Quality Assurance

415.3.4.1 Department Quality Assurance for HMA/WMA

New HMA Materials shall meet the requirements of Section 423.3.6.2.1, "Acceptance" and new WMA Materials shall meet the requirements of Section 424.3.6.2.1, "Acceptance," with the exception that the Department will base Acceptance on random test samples taken from the HMA or WMA before the Material goes through the paver.

415.3.4.2 Department Quality Assurance Testing for HMA or WMA Compaction

The Contractor shall meet the requirements of Section 423.3.6.2.1, "Acceptance" or Section 424.3.6.2.1, "Acceptance," as appropriate. The Project Manager will grant an exception to the mean density requirement of at least 93% of the theoretical maximum density if the Contractor can demonstrate that a minimum of 93% cannot be reasonably obtained because of the conditions of the existing Pavement Structure or Subgrade Materials. If the Project Manager grants this exemption, the Contractor shall construct a Roadway test strip and develop a HMA or WMA compaction process to get the highest possible density based on an approved roller's density gain per pass, in accordance with Section 423.3.4.4, "Compaction Equipment." The Project Manager will approve the process (except for the Roadway test strip) before paving operations begin. In no case shall the percentage of theoretical maximum density exceed 98% nor fall more than three (3) percentage points lower than the target density. If a lot does not meet either of these density requirements, the Project Manager will do the following:

1. Accept and pay for the lot of HMA Material at 50% of the Bid Item Unit Price; or
2. Reject the in-place Material and require the Contractor to remove and replace.

If the Project Manager determines that the mean measured densities are consistently higher, but not to exceed 93%, or lower than the current lot's target density, the Project Manager may establish a new Acceptance lot on the Project.

415.4 METHOD OF MEASUREMENT

Pavement surface restoration will be measured by the square yard.

415.5 BASIS OF PAYMENT

All Process Control and Quality Control Testing required shall be Incidental to Pavement Surface Restoration.

Pay Item	Pay Unit
<i>Pavement Surface Restoration</i>	Square Yard

415.5.1 Option A: In-Situ Cold Recycling of Existing Surfacing

If the actual quantity of polymerized high-float emulsion varies outside the range of one percent (1%) to two percent (2%), the Department will pay for or credit the actual amount of variation at the invoice cost for emulsion (per ton).

415.5.2 Work Included in Payment

The development of the Contractor Quality Control Plan shall be included in the payment and is considered incidental to the completion of this Bid Item. All references to Section 902, "Quality Control" are for reference only and no separate measurement will be made.

SECTION 416: MINOR PAVING

416.1 DESCRIPTION

This Work consists of constructing one (1) or more pavement courses of Hot Mix Asphalt (HMA) or Warm Mix Asphalt (WMA) on a prepared base or milled surface, and to include crushing, stockpiling, hauling, asphalt binder, mineral admixture, mix design, mixing, providing cold feeds, process control testing, and placement.

416.2 MATERIALS

The Contractor shall use Materials for minor paving in accordance with Section 423.2, "Materials."

416.3 CONSTRUCTION REQUIREMENTS

The Contractor shall perform minor paving in accordance with the following 423 Sections or the correlating 424 Sections:

1. Section 423.3.1, "Construction Requirements, General;"
2. Section 423.3.2, "Mix Temperature Requirements;"
3. Section 423.3.3, "Addition of Mineral Admixtures;"
4. Section 423.3.4, "Equipment;" and
5. Section 423.3.5, "Placement Operations" excluding 423.3.5.7, "Test Strip & Shakedown Period."

No referee testing will be required for Minor Paving, but may be used if both parties agree in writing at the Pre-Pave Conference. If used, referee testing will be done in accordance with Sections 423.3.7, "Dispute Resolution" and 424.3.7, "Dispute Resolution."

416.3.1 Sampling and Testing

416.3.1.1 Contractor Quality Control

The Contractor shall provide quality control measures in accordance with Section 902, "Quality Control."

416.3.1.2 Department Quality Assurance

The Department will provide quality assurance measures in accordance with Section 903, "Quality Assurance."

416.3.1.2.1 Acceptance

The Department will Accept the constructed product based on inspection and on Laboratory testing for conformance with the Contract. The Department will test samples of HMA/WMA taken from the Roadway before compaction. The Department will Accept the constructed product based on the following criteria:

1. Air voids as determined from Laboratory-compacted specimens in accordance with AASHTO T 166 and AASHTO T 209;
2. Asphalt content as determined by the tank strap method or plant asphalt metering system defined in the Contractor's Quality Control Plan (binder ignition oven calibration samples will not be required);

3. Final thickness of the compacted Material as measured from cores in accordance with ASTM D 3549; and
4. Density of the compacted Roadbed as determined in accordance with AASHTO T 310, Standard Method of Test for In-Place Density and Moisture Content of Soil-Aggregate by Nuclear Methods (Shallow Depth). Daily densities will be calculated using the current running average Gmm for the lot. The Contractor shall provide cores from three (3) locations designated by the Project Manager for correlation with the Nuclear Densometer. A new correlation factor can be requested if a change in Materials or conditions has occurred or if the accuracy of the established correlation factor is in question.

The Project Manager may reject Material that appears to be defective based on visual inspection.

Department representatives, certified in the relevant test procedures by the State Materials Bureau through TTCP, will perform Acceptance testing in accordance with AASHTO or Department methods, using the test methods and modifications in the current TTCP Manual.

416.3.1.2.1.1 Acceptance Lots and Pay Factor Determination

The Contractor shall identify the proposed Lot size in the Quality Control Plan for approval by the Project Manager. The Department will Accept density based on the average of all nuclear density tests per Lot, taken at a minimum of ten (10) nuclear density tests per Lot, and will Accept air voids and asphalt content based on the average of a minimum of three (3) tests per Lot.

The Department will determine pay factors in accordance with:

1. Table 416.3.1.2.1.1:1, "Price Adjustments for Density,"
2. Table 416.3.1.2.1.1:2, "Price Adjustments for Air Voids,"
3. Table 416.3.1.2.1.1:3, "Price Adjustments for Asphalt Content," and
4. Table 416.3.1.2.1.1:4 "Price Adjustment for Thickness."

The Department will obtain the TVs for asphalt content and air voids from the approved JMF and will determine payment for each Acceptance lot by multiplying the Bid Item Unit Price by the average of the pay factors per lot and multiplying the result by the total lot area or tonnage.

**Table 416.3.1.2.1.1:1
Price Adjustments for Correlated In-place Nuclear Density**

Percent density	Pay factor (%)
> 97.99	Reject
97.0 – 97.99	90
96.0 – 96.99	95
92.50 – 95.99	100
91.50 – 92.49	95
90.50 – 91.49	90
90.00 – 90.49	80
< 90.00	Reject

**Table 416.3.1.2.1.1:2
Price Adjustment for Air Voids**

Percent deviation from TV	Pay factor (%)
< 1.4	100
1.41 – 1.69	90
1.7 – 1.99	75
≥ 2.0	Reject

**Table 416.3.1.2.1.1:3
Price Adjustment for Asphalt Content**

Percent deviation from TV	Pay factor (%)
< 0.35	100
0.36 – 0.55	90
≥ 0.56	Reject

**Table 416.3.1.2.1.1:4
Price Adjustment for Thickness**

Deficiency from plan minimum thickness	Pay factor (%)
None (Plan Minimum or Thicker)	100
<1/4 inch	100
1/4 inch–1/2 inch	90
1/2 inch–3/4 inch	75
3/4 inch–one (1) inch	50
>one (1) inch	Corrective action

The Contractor shall remove and replace rejected Material identified in Table 416.3.1.2.1.1:1, “Price Adjustment for Density,” Table 416.3.1.2.1.1:2, “Price Adjustment for Air Voids,” and Table 416.3.1.2.1.1:3, “Price Adjustments for Asphalt Content.” Instead of removing and replacing rejected Material, the Project Manager may allow the Material to remain in place at 50% of the Bid Item Unit Price, if in the best interest of the Department.

The Contractor shall take corrective action if specified in Table 416.3.1.2.1.1:4, “Price Adjustment for Thickness.” Corrective action includes removal and replacement of the unacceptable Material, overlay of the unacceptable Material, or other corrective actions approved by the Project Manager. Thin or feathered edge surface patching is not Acceptable. Overlay lift thicknesses must meet the requirement of Table 416.3.1.2.1.1:5, “HMA/WMA Lift Thickness.”

**Table 416.3.1.2.1.1:5
HMA/WMA Lift Thickness**

HMA Type	Lift Thickness (Inches)	
	Minimum	Maximum
SP-III	2.5	3.5
SP-IV	1.5	3.0
SP-V	0.75	1.5

416.3.1.3 Independent Assurance Testing

The Department will perform Independent Assurance sampling and testing in accordance with Section 906, "Minimum Testing Requirements."

416.4 METHOD OF MEASUREMENT

If the Department measures by the square yard, the Department will measure minor pavement using the dimensions shown in the Contract or approved field measurements.

416.5 BASIS OF PAYMENT

The Department will adjust payment for minor pavement in accordance with Section 416.3.1.2.1.1, "Acceptance Lots and Pay Factor Determination."

Pay Item	Pay Unit
<i>Minor Pavement</i>	Ton or Square Yard

416.5.1 Price Adjustments

The Department will pay for Accepted quantities of Minor Pavement at the Bid Item Unit Price, adjusted in accordance with this section. The Minor Pavement will be evaluated on a lot-by-lot basis at a price determined by multiplying the Bid Item Unit Price by the composite pay factor for the lot. The Department will use the sum of Table 416.5.1.1:1, "Weighting Factors," multiplied by the Pay Factors of Table 416.3.1.2.1:1, "Pay factor for Correlated In-place Nuclear Density;" Table 416.3.1.2.1:2, "Pay factor for Air Voids;" Table 416.3.1.2.1:3, "Pay factor for Asphalt Content;" and Table 416.3.1.2.1:4, "Pay factor for Thickness" to calculate each lot's composite pay factor. If the composite pay factor for a lot is greater than one (1.0), the pay factor will be set at one (1.0).

**Table 416.5.1:1
Weighting Factors**

Characteristic	"f" Factor (%)
Correlated In-place Nuclear Density Mat Density	35
Air voids	35
Asphalt Content	20
Thickness	10

416.5.2 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Asphalt binder, aggregate, blending sand, mineral filler, mineral admixture, and WMA additive or process as appropriate;
2. Mixing, hauling, placement, and compaction of HMA or WMA;
3. Providing Mix Design in accordance with Section 423.2.8' "Mix Design;"
4. Quality Control in accordance with Section 902, "Quality Control;"
5. Providing and transporting all cores for correlation; and
6. Providing storage container for samples and cores if referee testing is used.

SECTION 417: MISCELLANEOUS PAVING

417.1 DESCRIPTION

This Work consists of constructing one (1) or more courses of asphalt paving on a prepared surface.

Examples of miscellaneous paving include the following:

1. Ditch paving;
2. Median paving;
3. Slope paving;
4. Guardrail pads, bicycle/pedestrian paths and trails;
5. Asphalt curbs; or
6. As designated in the Plans.

417.2 MATERIALS

The asphalt paving consists of coarse and fine aggregates, asphalt binder, mineral filler, and hydrated lime or anhydrate based Material.

417.2.1 Aggregate

The Contractor shall use aggregate that meets the requirements in Table 417.2.1:1, "Aggregate Gradation Requirements."

**Table 417.2.1:1
Aggregate Gradation Requirements**

Sieve size	% passing
3/4 inch	100
No. 4	40 – 70
No. 200	< 10

Coarse aggregate shall have an AI of 30 or less in accordance with Section 910, "Aggregate Index." The combined aggregate shall have a minimum sand equivalent of 45.

417.2.2 Asphalt Material

The Contractor shall use the type and grade of asphalt Material specified in the Contract. If no grade is specified, the Contractor shall use any performance-graded asphalt binder in accordance with Section 402, "Asphalt Materials and Mineral Admixtures."

The Contractor shall use asphalt mixture with sufficient asphalt binder to produce a design air voids of four percent (4%) or less, except for ditch paving, which shall have a design air voids of three percent (3%) or less. The Contractor shall use the superpave gyratory compactor at N (design) of 75 gyrations to determine the percentage. The Contractor shall use asphalt Material content that meets requirements for workability and desired surface texture.

417.2.3 Reclaimed Asphalt Pavement (RAP)

The Contractor may use RAP miscellaneous paving in any amount up to 35% of the total weight of the mix, providing the other provisions of this specification are met.

417.2.4 Job Mix Formula

The Contractor shall submit a JMF proposal to the Project Manager for approval at least 14 Days before paving. The JMF shall include the following:

1. Stockpile combination percentages and resulting gradation;
2. Source, grade, and percentage of asphalt binder; and
3. Any other information that will assist the Project Manager in evaluating the appropriateness of the mix design.

The Contractor shall not begin miscellaneous paving until the Project Manager has approved the JMF.

The Contractor may substitute any approved mix design that complies with the requirements of Section 423, "HOT MIX ASPHALT (HMA) MAJOR PAVING," Section 424, "WARM MIX ASPHALT (WMA)," or Section 416, "MINOR PAVING" instead of the requirements of this section.

The Contractor shall submit proposed changes to the approved JMF to the Project Manager for approval before placement.

417.3 CONSTRUCTION REQUIREMENTS

417.3.1 Mixing Plants

The Contractor shall prepare HMA or WMA for miscellaneous paving in an asphalt plant of typical configuration and in good repair. The Contractor may use drum or batch mixing plants in accordance with Section 423.3.4, "Equipment." No referee testing will be required for Miscellaneous Paving. Referee testing may be used if both parties agree in writing prior to commencing placement operations for Miscellaneous Paving.

417.3.2 Haul Equipment

The Contractor shall use haul Equipment in accordance with Section 423.3.4.2, "Haul Equipment."

417.3.3 Placement Operations

Unless otherwise specified in the Contract, the Contractor shall:

1. Prepare the surface by compacting the top six (6) inches of soil to 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTTCP Modified);
2. Place asphalt mixtures in accordance with the Plans, or as directed by the Project Manager. The surface of the placed mix shall be smooth and uniform in texture;
3. The Contractor shall compact with a mechanical roller of suitable type and size to obtain the density and surface texture specified in the Plans;
4. Cross-roll ditch paving with a pneumatic roller or by other approved means to produce a corrugated texture; and
5. Roll and consolidate Median and slope paving, and guardrail pads to a uniform texture.

417.3.4 Temperature and Weather Limitations

The Contractor shall perform miscellaneous paving in accordance with Section 423.3.5.1, "Temperature and Weather Limitations."

417.3.5 Acceptance

The Contractor shall correct or remove Material that the Project Manager determines is improperly coated or segregated or that otherwise fails to meet the requirements of this Specification.

The Department will base Acceptance of miscellaneous paving on visual examination, verification of line and grade, and by density testing (if required). The Department will require density testing on bicycle/pedestrian paths and trails.

When densities are required the Contractor shall make three (3) passes in the first 100 feet of paving with compaction equipment to be used in production and three (3) densities will be taken. The three (3) densities will be averaged and used for the maximum density for the Project. Placement of the HMA/WMA shall meet the proper compaction temperature and thickness (as shown on the Plans).

Acceptance lots for density will be a maximum of 500 yd². The Contractor shall take three (3) nuclear density readings at random locations within the Acceptance lot and use the average of the three (3) tests for pay factor determination. The Department will determine the pay factor for each lot in accordance with Table 417.3.5:1, "Price Adjustments for Density."

The Project Manager may reject Material that appears to be defective based on visual inspection.

**Table 417.3.5:1
Price Adjustments for Density**

Percent of Determined Maximum Density	Pay factor (%)
≥ 98	100
95.0 – 97.9	95
92.0 – 94.9	80
< 92.0	Reject

The Contractor shall remove and replace rejected Material identified in Table 417.3.5:1, "Price Adjustment for Density." Instead of removing and replacing rejected Material, the Project Manager may allow the Material to remain in place at 50% of the Bid Item Unit Price, if in the best interest of the Department.

417.4 METHOD OF MEASUREMENT

The Department will measure all pay items using the dimensions shown in the Contract or approved modifications.

417.5 BASIS OF PAYMENT

The Department will adjust payment for miscellaneous paving in accordance with Section 417.3.5, "Acceptance."

Pay Item	Pay Unit
<i>Miscellaneous Paving</i>	Square Yard

417.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Asphalt binder, aggregate, blending sand, mineral filler, mineral admixture, and WMA additive or process as appropriate;
2. Mixing, hauling, placement, and compaction of HMA or WMA;
3. Quality Control in accordance with Section 902, "Quality Control;" and
4. Providing Mix Design in accordance with Section 423.2.8, "Mix Design."

SECTION 423: HOT MIX ASPHALT (HMA) (MAJOR PAVING)

423.1 DESCRIPTION

This Work consists of constructing one (1) or more pavement courses of Hot-Mix Asphalt (HMA) on a prepared base, to include crushing, stockpiling, hauling, binder, mineral admixture, mix design, mixing, providing cold feeds, process control testing and placement.

423.2 MATERIALS

423.2.1 General

HMA is a mixture of asphalt binder, aggregate, blending sand, mineral filler, and mineral admixture. Unless otherwise prohibited in the Contract, the Department will allow Recycled Asphalt Pavement (RAP) in HMA mixtures as long as the resulting mixture conforms to all Specification requirements.

The Contractor shall size, uniformly grade, and combine aggregate fractions in accordance with the Contract. The Contractor shall test Materials in accordance with applicable AASHTO/ASTM methods, as modified by the Department (if applicable) or other test procedures as directed by the Department. The State Materials Bureau will decide all questions pertaining to the interpretation of test procedures.

423.2.2 Aggregate

The Contractor shall ensure the aggregate gradation of the HMA mixture meets the requirements of Table 540

.2.2.1:1, "HMA Aggregate Gradation Control Points." The Project Manager may require, at no additional cost to the Department, wet preparation, per AASHTO T 146, Method A, if the Project Manager determines there are Deleterious Materials present in the aggregate stockpiles before aggregate gradation testing. The Contract will specify the type of HMA the Contractor is to use. The Department will allow the Contractor to combine Materials from two (2) or more sources to produce aggregate only when each individual aggregate source meets all applicable quality requirements.

423.2.2.1 Gradation and Quality Requirements

**Table 423.2.2.1:1
HMA Aggregate Gradation Control Points**

Sieve size	% passing per HMA type							
	SP-II		SP-III		SP-IV		SP-V	
	Min	Max	Min	Max	Min	Max	Min	Max
Two (2) inch	—	—	—	—	—	—	—	—
1 1/2 inch	100	—	—	—	—	—	—	—
One (1) inch	90	100	100	—	—	—	—	—
3/4 inch	—	90	90	100	100	—	—	—
1/2 inch	—	—	—	90	90	100	100	—
3/8 inch	—	—	—	—	—	90	90	100
No. 8	19	45	23	49	28	58	32	67
No. 200	1.0	7.0	2.0	8.0	2.0	10.0	2.0	10.0

423.2.2.1.1 Aggregate Quality

For each Material source, the Contractor shall ensure the HMA coarse aggregate has an AI of 25 or less when calculated in accordance with Section 901, "QUALITY CONTROL/QUALITY ASSURANCE (QC/QA)."

The Contractor shall regulate the crushing of aggregate to:

1. Minimum Fractured Faces content of the plus No. 4 Material complies with the requirements of Table 423.2.2.1.2:1, "Fractured Faces, Sand Equivalent, and Fine Aggregate Angularity," and evaluation by AASHTO 335-09, "Fractured Face Determination for Coarse Aggregate;"
2. Ensure the combined plus 3/8 inch material contains no more than 20% flat, elongated particles with a dimensional ratio of 3:1 or greater as determined by ASTM D 4791 (TTCP Modified);
3. Ensure the combined Material, excluding RAP; passing the No. 40 sieve is non-plastic;
4. Ensure that before the addition of mineral admixtures, the minimum sand equivalent value and the minimum fine aggregate angularity value of the combined aggregate, excluding RAP, complies with the requirements of Table 423.2.2.1.2:1, "Fractured Faces, Sand Equivalent, and Fine Aggregate Angularity;" and
5. Determine the Sand Equivalent value in accordance with AASTHO T 176, Alternate Method No. 1, and Fine Aggregate Angularity value in accordance with AASHTO T 304, Method A.

423.2.2.1.2 Fractured Faces

The Department will consider a face to be fractured when at least one-half of the projected particle area exhibits a rough, angular, or broken texture with well-defined edges.

**Table 423.2.2.1.2:1
Minimum Fractured Faces, Sand Equivalent, and Fine Aggregate Angularity for Virgin Aggregates**

Design Traffic, ESALs ^a x 10 ⁶	Fractured Faces ^b	Sand Equivalent (%)	Fine Aggregate Angularity
< 3.0	75.0 / —	45.0	40.0
≥ 3.0 – < 10.0	85.0 / 80.0	45.0	45.0
≥ 10.0 – < 30.0	95.0 / 90.0	45.0	45.0
≥ 30.0	99.0 / 95.0	50.0	45.0

^aESALs are based on a 20-year design life for all scenarios.

^bUnder "Fractured Faces," 85.0 / 80.0 denotes that 85.0% of the coarse aggregate has at least one (1) Fractured Face and 80.0% has at least two (2) Fractured Faces.

Ensure RAP provided from sources outside the Project has at least 75% Fractured Faces (one (1) Fractured Face); however, Sand Equivalent and Fine Aggregate Angularity do not apply.

423.2.2.2 Production

When producing aggregates for HMA, the Contractor shall:

1. Remove natural fines by screening and stockpiling separately;

2. Use a No. 4 screen, minimum, or a larger screen if needed to properly control the crushing and screening operation;
3. Crush the aggregate retained on the scalping screen and separate the crushed Material into at least two (2) stockpiles of fine and coarse aggregates; and
4. Regulate crushing operations to produce Material that meets design requirements when combined.

423.2.2.3 Stockpiling

The following requirements apply to stockpiles, the Contractor shall:

1. Place stockpiles upon prepared sites;
2. Make stockpiles neat and regular to prevent segregation;
3. Provide enough storage space for each size of aggregate;
4. Separate the aggregate stockpiles far enough apart to prevent mixing, or with walls or partitions;
5. Prevent contamination (store stockpiles away from vehicular and Equipment traffic);
6. Keep the storage yard neat and orderly and keep the stockpiles accessible for sampling; and
7. Keep the aggregate sizes separated until delivered to the cold feed system that feeds the drier.

423.2.2.4 Combining

When combining crushed Materials from different stockpiles, including RAP (if in the mixture); the Contractor shall ensure the product is in accordance with the mix design gradation requirements. The Contractor shall use controlled feeders from each stockpile to combine crushed Material.

423.2.3 Asphalt Binder

The Contract will specify the type and grade of asphalt binder. The Contractor shall provide asphalt binders in accordance with Section 402, "Asphalt Materials and Mineral Admixtures." The Contractor shall not change the asphalt source after approval of the mix design without written approval of the State Materials Bureau.

423.2.4 Mineral Admixtures

The Contractor shall provide mineral admixtures in accordance with Section 402, "Asphalt Materials and Mineral Admixtures."

423.2.5 Blending Sand

Blending sand consists of the following:

1. Natural fines from the scalping process;
2. Concrete sand;
3. Sandy Material; or
4. A combination of these, graded to the mix design requirements.

The Contractor shall determine the need for and percentage (a maximum of 20.0%) of blending sand using mix design tests on samples taken from stockpiles during crushing operations and submitted to an approved testing Laboratory.

423.2.6 Mineral Filler

The Contractor shall, if required by mix design, provide mineral filler in accordance with AASHTO M 17 and approved by the State Materials Bureau. The Department will not allow fly ash as mineral filler for HMA.

423.2.7 Reclaimed Asphalt Pavement (RAP)

Unless otherwise specified in the Contract, the Contractor may use RAP removed under the Contract consisting of salvaged, milled, pulverized, broken, or crushed asphalt pavement. The Contractor may use RAP produced from outside sources provided the following is met: after the Contractor obtains sufficient quantities of RAP aggregate samples in accordance with AASHTO T 308; the Department will Accept RAP for which the coarse aggregate has a percent wear of 40.0 or less, at 500 revolutions, when tested in accordance with AASHTO T 96. The Contractor shall provide plus No. 4 RAP Material with a minimum of 75% Fractured Faces content (one (1) face). The Department will make no additional payment for the asphalt binder in the RAP or asphalt binder due to asphalt binder grade adjustment.

The Contractor may use a maximum of 15% RAP (by weight) in the production of HMA mixtures without changing the asphalt binder.

For quantities greater than 15% and up to 25% RAP, the Contractor shall:

1. Either lower the asphalt binder's high and low temperature grades by one (1) grade (e.g. lower a PG 76-22 to a PG 70-28); or
2. Extract, recover, and combine the RAP's asphalt binder with a virgin asphalt binder per AASHTO M 323, Appendix A, ensuring the resultant binder meets the entire AASHTO M 320 (excluding direct tension) required Project PG asphalt binder properties indicated on the approved mix design.

For quantities greater than 25% and up to 35% RAP, the Contractor shall:

1. Extract, recover, and combine the RAP's asphalt binder with a virgin asphalt binder per AASHTO M 323, Appendix A; and
2. Ensure the resultant binder meets the entire AASHTO M 320 (excluding direct tension) required Project PG asphalt binder properties indicated on the approved mix design.

The Department will not allow the Contractor to use more than 35% RAP in the production of HMA mixtures.

For Projects of entirely new construction, the Contractor shall:

1. Limit the RAP to 15% in the top mat or extract, recover and combine the RAP's asphalt binder with a virgin asphalt binder per AASHTO M323, Appendix A; and
2. Ensure the resultant binder meets the entire AASHTO M320 (excluding direct tension) required Project PG asphalt binder properties indicated on the approved mix design.

If Plus Grades of PG asphalt binder is specified on the project, for quantities greater than 15% RAP, the Contractor shall extract, recover, and combine the RAP's asphalt binder with a virgin asphalt binder per AASHTO M 323, Appendix A. The Contractor shall ensure the

resultant binder meets the entire AASHTO M 320 required Project PG asphalt binder properties indicated on the approved mix design including the additional Plus Grade requirements for Elastic Recovery and Solubility.

The Contractor shall:

1. Process RAP so that 100% passes a 1-1/2-inch sieve;
2. Maintain adequate stockpile management (i.e. sufficient quantities and shaping of the stockpiles);
3. Address in the Quality Control Plan how RAP will be controlled, such as which screen will be used to split into two (2) stockpiles, or by what method the RAP will be controlled to keep the resultant mix within Acceptable limits;
4. Account for the weight of the binder in the RAP when batching aggregates;
5. Provide RAP that is free of Deleterious Materials; and
6. Perform process control testing in accordance with Section 901, "Quality Control/Quality Assurance (QC/QA)" and Table 901.5:3, "Minimum Process Control Guidelines for Aggregates, Base Course, and RAP (QC);" as RAP is produced and prepared for inclusion in the HMA.

If problems with HMA consistency or compliance with Project Specifications occur, additional efforts taken to achieve Acceptable levels of consistency and compliance with Contract Specifications, at the Contractor's discretion (at no additional cost to the Department), include, but are not limited to:

1. Reduce the top size of the RAP from 1-1/2 inch to one (1) inch;
2. Fractionate the aggregates on a second screen, such as the 3/8 inch or 1/4 inch Screen so that the RAP is maintained in three (3) stockpiles, one being RAP larger than 1-1/2 inch to two (2) inches, Coarse RAP and the third being Fine RAP;
3. Ensure that the RAP used in the HMA mix design is representative of the RAP available on the Project;
4. Cover the RAP pile(s) so that ambient moisture is not absorbed; and
5. Process and maintain the stockpiles so that the RAP Material is equally and uniformly distributed throughout the entire stockpile(s) and is withdrawn such that uniform, non-segregated RAP is delivered to the hoppers.

423.2.8 Mix Design

The Contractor shall provide a mix design developed by a Department approved testing Laboratory, reviewed and signed by a professional Engineer licensed by the New Mexico Board of Registration for Professional Engineers and Land Surveyors. A list of approved private testing laboratories is available from the State Materials Bureau. The Contractor shall develop the mix design at no additional cost to the Department. The Contractor may develop the mix design at any time prior to the Project Pre-Paving Conference.

The Contractor shall provide to the State Asphalt Engineer the mix design developed in accordance with the Contract documents and AASHTO R35 as modified by NMDOT for review and concurrence. The Contractor shall summarize the mix design results from the Department approved testing Laboratory in a format approved by the State Materials Bureau. Department concurrence of a mix design will not relieve the Contractor of full responsibility for producing an Acceptable mixture. The mix design may require adjustment in accordance with Section 423.2.9, "Job Mix Formula."

The Department will require a minimum of one percent (1.0%) for mix designs that include hydrated lime, anhydrite based Material, or Portland cement. The Contractor shall include these mineral admixtures in the gradation for developing the mix design. AASHTO T 354 may be used in lieu of AASHTO T 84/T 85. If lubricating antistripping is used as a mineral admixture, the percent dosage shall be done in accordance with the manufacturer's recommendation and approved by the Contractor's design Lab. Lubricating antistripping shall be approved by the Department and included in the most current Approved Products List (APL). The mix design shall be in accordance with Table 423.2.8:1, "HMA Superpave Design Requirements for Aggregates with Less Than three percent (3.0%) Absorption," or Table 423.2.8:2, "HMA Superpave Design Requirements for Aggregates with three percent (3.0%) or Greater Absorption."

The Contractor shall test the HMA in accordance with AASHTO T 283, as indicated below:

1. Use six (6) inch diameter specimens; Compact all test specimens in accordance with AASHTO T 312;
2. Conditioned specimens shall include one (1) freeze thaw cycle;
3. On the AASHTO T283 Section 11.3 scale of zero (0)-five (5), with five (5) exhibiting the most damage from moisture, visually estimate the amount of damage caused by moisture on the interior surfaces of each broken specimen; and
4. The tensile stress ratio shall be a minimum of 85%.

The Contractor shall provide a mixture that meets all applicable criteria. If tests indicate the need for additives or modifiers not specified in the Contract or a change in source of binder to satisfy mix design requirements, the Contractor shall perform the required changes at no additional cost to the Department.

**Table 423.2.8:1
HMA Superpave Design Requirements for Aggregates with Less Than 3.0%
Absorption**

(a) 20-year design ESALS	N initial	N design (b)	N max	Percent Voids in the Mineral Aggregate (VMA) per nominal maximum aggregate size				Voids Filled with Asphalt (VFA) Range, % (c)	Dust to Binder Ratio Range
				One (1) Inch					
				(SP-II)	3/4 Inch (SP-III)	1/2 Inch (SP-IV)	3/8 Inch (SP-V)		
< 0.3	<91.5			12.5	13.5	14.5	15.5	72.0–80.0	0.6 to 1.4
0.3-3.0	<90.5	96.0	< 98.0	14.0	15.0	16.0	17.0	68.0–78.0	
≥3.0	<89.0							68.0–75.0	

**Table 423.2.8:1
HMA Superpave Design Requirements for Aggregates with Less Than 3.0%
Absorption**

20-year design ESALS	N initial	N design (b)	N max	Percent Voids in the Mineral Aggregate (VMA) per nominal maximum aggregate size				Dust to Binder Ratio Range

^aIn Millions.

^bDesign Air Void Content of four percent (4%).

^cFor one (1) inch nominal maximum size mixtures, the specified lower limit of the VFA shall be 70% for the design traffic level <0.3 million ESALs.

**Table 423.2.8:2
HMA Superpave Design Requirements for Aggregates with 3.0% or
Greater Absorption**

20-year design ESALS (a)	N initial	N design (b)	N max	Percent Voids in the Mineral Aggregate (VMA) per nominal maximum aggregate size				Voids Filled with Asphalt (VFA) Range, % (c)	Dust to Binder Ratio Range
				One(1) inch (SP-II)	3/4 inch (SP-III)	1/2 inch (SP-IV)	3/8 inch (SP-V)		
<0.3	<91.5							70.0–80.0	
0.3–<3.0	<90.5	96.5	> 98.0	12.0 – 14.0	13.0 – 15.0	14.0 – 16.0	15.0 – 17.0	65.0–78.0	0.6 to 1.4
≥3.0	<89.0							65.0–78.0	

^aIn Millions.

^bDesign Air Void Content of 3.5%.

^cFor one (1) inch nominal maximum size mixtures, the specified lower limit of the VFA will be 70% for the design traffic level <0.3 million ESALs.

Department reviewed commercial mix designs are Acceptable for use on NMDOT Projects with the concurrence of the State Asphalt Engineer. The commercial mix design will be submitted for review and concurrence by the State Asphalt Engineer for conformance with the Contract documents and re-issued with Project information.

An approved mix design is valid up to one (1) year from the date of review. If the Aggregate Index expires within that year, a new Aggregate Index needs to be established in order to keep the mix design valid. The Contractor shall submit a new mix design if changing the source of Materials.

For Projects that are longer than one (1) year and aggregate Materials are produced and stockpiled the mix design and Aggregate Index (AI) may be approved for an extension by the State Asphalt Engineer.

423.2.9 Job Mix Formula

The Job Mix Formula (JMF) must be in accordance with all aggregate gradation requirements and result in a mix that meets all specified mix design requirements. The Department will refer to the result of the Laboratory mix design developed in accordance with Section 423.2.8, "Mix Design," as JMF1.

423.2.9.1 Job Mix Formula Adjustment

The Contractor may request a modification to the JMF based on field testing of Material produced through the plant. Test results and calculations that verify a proposed JMF adjustment complies with the Specifications will be required prior to being reviewed by the Project Manager, District Lab Supervisor, and concurred by the State Asphalt Engineer. Review and concurrence of a JMF adjustment can only be made after:

1. JMF adjustment results in a new TV that is within the tolerance from the design TV. (Example: If design TV for No. 4 sieve is 30%, then a new TV may be approved in the field from 23% - 37%);
2. Submittal by the Testing Laboratory responsible for the original mix design to the Project Manager with a copy to the State Asphalt Engineer;
3. Confirmation by the Project Manager that the Quality Control Plan is being followed; and
4. If the JMF is adjusted after the Shakedown Period, the Contractor shall terminate the current lot. Once the adjusted JMF has been reviewed and concurred by the Project Manager, Assistant District Engineer for Construction and the State Asphalt Engineer; the Contractor shall begin a new lot with the adjusted JMF.

423.3 CONSTRUCTION REQUIREMENTS

423.3.1 General

The Contractor shall:

1. Provide sufficient storage space for each size of aggregate and RAP;
2. Keep the different sizes separate and ensure that segregation, degradation, or combination of Materials of different aggregate sizes does not occur until delivery to the cold feed system;
3. Re-screen or waste segregated or degraded Material;
4. Provide separate storage and feeder for mineral filler if the Contract requires mineral filler; and
5. If the Project Manager determines that uncoated aggregate exists, the Contractor shall take corrective action.

423.3.2 Mix and Laydown Temperature Requirements

The Contractor shall not allow the temperature of the HMA discharged from the mixer into the transport vehicle to be greater or less than ten percent (10%) of the target mixing temperature specified in the mix design, not to exceed 350° F, unless written concurrence by the asphalt binder supplier and design lab are provided to the Project Manager.

HMA delivered to the Project with mix temperatures outside the acceptable laydown temperature range as specified in the mix design shall, at the sole discretion of the Project Manager, be removed and replaced at no cost to the Department.

423.3.3 Addition of Mineral Admixtures

The Contractor shall:

1. Monitor the out feed of the mineral admixture with sensors that provide audible and visual signals to control the out feed with an accuracy of \pm three percent (3.0 %) by weight;
2. Control the mineral admixture content such that it meets the range specified in the approved mix design;
3. Add the mineral admixture to the aggregate in an enclosed pug mill immediately after leaving the cold feed and just before introduction into the drier drum or aggregate drier; and
4. Minimize the loss of mineral admixture while adding to the aggregate.

When mixing the aggregate and mineral admixture, the Contractor shall maintain the moisture content of the combined aggregate at the recommended moisture content as shown on the approved mix design.

423.3.4 Equipment

423.3.4.1 Mixing Plants

423.3.4.1.1 Plant Scales

The Contractor shall ensure that the scales are accurate to 0.5% of the maximum allowable load in accordance with the Federal Motor Carrier Safety Administration (FMCSA) publication, as certified by a licensed scale technician. The Contractor shall submit a copy of the certification to the Project Manager.

423.3.4.1.2 Storage of Asphalt Binder Materials

The Contractor shall provide storage tanks for asphalt binder capable of holding, heating and circulating the asphalt at the required temperatures and measuring the temperature of the asphalt in the tank.

The Contractor shall allow measuring and sampling of asphalt binder from the delivery trucks upon arrival.

423.3.4.1.3 Feeder for Drier

The Contractor shall equip the plant with an accurate feeding mechanism to deliver the aggregate into the drier and maintain uniform production.

423.3.4.1.4 Drier

The Contractor shall equip the plant with a system to continuously agitate the aggregate during the heating and drying process. The Contractor shall use a drier that can dry and heat the aggregate and prevent fuel oil or carbon from coating the aggregate. The Contractor shall take corrective action if the aggregate becomes coated with burner fuel.

423.3.4.1.5 Bins

The Contractor shall equip the plant with storage bins large enough to supply the mixer when it is operating at full capacity and arrange the bins to ensure separate and adequate

storage of the appropriate aggregate sizes. The Contractor shall equip the bins with warning devices that notify the control panel when the bins are low.

423.3.4.1.6 Asphalt Binder Control Unit

The Contractor shall equip the plant with a scale or meter to control the rate of flow to determine the amount of asphalt binder added to the mix.

423.3.4.1.7 Thermometers

The Contractor shall equip the discharge chute of the drier with a recording thermometer to register the temperature of the heated aggregates or mix. The Contractor shall provide the Project Manager with a record of discharge temperatures at the end of each week's production or as requested by the Project Manager.

423.3.4.1.8 Truck Scales

The Contractor shall weigh the HMA on approved plant or truck scales provided by the Contractor or public scales in accordance with Section 109.1, "Measurement of Quantity."

423.3.4.1.9 Requirements for Batching Plants

423.3.4.1.9.1 Weigh Box or Hopper

The Contractor shall provide a batching plant that can accurately weigh aggregate in a weigh box or hopper suspended on scales. The Contractor shall use a weigh box or hopper that can hold a full batch. The Contractor shall ensure that the gate of the weigh box or hopper does not allow Material to leak into the mixer while being weighed. The Contractor shall test the scales in accordance with Section 109.1, "Measurement of Quantity."

423.3.4.1.9.2 Mixer

The Contractor shall provide a batch mixer with a capacity of at least 2,000 lb, capable of producing a uniform mixture within specified tolerances.

423.3.4.1.9.3 Control of Mixing Time

The Contractor shall equip the mixer with an accurate timing device that signals the end of the mixing time.

423.3.4.1.10 Drum Mix Plants

The Contractor shall equip the drum mix plant with the following auxiliary Equipment and capabilities:

1. Separate cold feed controls for each Material;
2. An automatic interlocking device for cold feed, asphalt, and mineral admixtures;
3. A means for controlling moisture content of aggregate. A means for sampling individual cold feeds and provisions for sequential sampling of aggregate, RAP, asphalt binder, and mineral admixtures;
4. Equip the bins with mechanical or electrical devices that provide an audible or visual warning when the bins are less than 1/4 full;
5. Bins shall be designed and equipped to prevent segregation;

6. Equip the bin containing fine aggregate and filler, if required, with a device that prevents Material hang-up during plant operation;
7. A minimum of one (1) cold feed bin for each aggregate size in the mix;
8. Equip the cold feed with mechanical or electrical devices that indicate with an audible or visual warning when the cold feed belt is not carrying the proper amount of Material;
9. A separate cold feed for RAP Material. Introduce RAP so that it does not come into direct contact with the burner flame; and
10. Couple the asphalt feed control with the total-aggregate-weight measurement device to automatically vary the asphalt feed rate to maintain the required proportion.

423.3.4.2 Haul Equipment

The Contractor shall haul asphalt mixtures with trucks that are tarped and have tight, clean, smooth metal beds and a thin coat (a minimal amount) of a Department approved release agent in accordance with Section 423.3.4.2.1, "Asphalt Release Agent (ARA)."

423.3.4.2.1 Asphalt Release Agent (ARA)

The Contractor shall use Asphalt Release Agents (ARA) for prevention of asphalt mixtures adhering to haul trucks and any other type of Equipment that is used for asphalt paving operations. ARA shall meet the requirements of Table 423.3.4.2.1:1, "Asphalt Release Agent Properties" and shall be on the NMDOT's Approved Products List. All testing will be in accordance with NTPEP Evaluation of Asphalt Release Agents AASHTO ARA 14.

**Table 423.3.4.2.1:1
Asphalt Release Agent Properties**

Test	Result
7-Day Asphalt Stripping Test	
Diluted	No Stripping
Full Strength	No Stripping
Mixture Slide Test (truck beds)	10 g retained, maximum
Asphalt Performance Test	Does not fall after 3 pours

423.3.4.3 Pavers

The Contractor shall use self-contained, self-propelled pavers, with activated screeds or strike-off assemblies, heated if necessary, and capable of spreading and finishing courses of HMA in accordance with the Plans.

423.3.4.4 Compaction Equipment

The Contractor shall provide a sufficient number, weight, and type of rollers to obtain the required compaction and specified pavement density while the HMA is in a workable condition. All rollers must be capable of reversing direction without shoving or tearing the mixture.

423.3.5 Placement Operations

For cold milled surfaces, the Contractor shall prepare the surface in accordance with Section 414, "Cold Milling." The Contractor shall clean the existing surfaces and apply a tack coat as required in the Plans or at an application rate as approved by the Project Manager in accordance with Section 407, "Tack Coat."

The Contractor shall place HMA on prepared Base Course in accordance with Section 303, "Base Course." The Contractor shall apply prime coat as required in the Plans or at an application rate as approved by the Project Manager in accordance with Section 408, "Prime Coat."

The Contractor shall place the HMA on the Accepted surface, spread and compact to specified width, lift thickness, and cross slope in accordance with the Plans.

Materials Transfer Vehicle (MTV): The Contractor shall use a MTV with storage and remixing capabilities on all mainline construction that utilizes greater than 25% RAP when placing HMA State approved designs. The MTV will independently remix and deliver mixture from the hauling Equipment to the paving Equipment.

The Contractor shall furnish an MTV with the following capabilities:

1. An unloading system to receive mixtures from the hauling Equipment;
2. A minimum storage capacity of 13 tons with a remixing system in the MTV storage bin;
3. A discharge conveyor to deliver the mixture to the paver hopper; and
4. The MTV system cannot exceed maximum legal loading on Structures.

Pick-up machines, hopper inserts and Material transfer devices are not considered MTVs.

In the event the MTV malfunctions during paving operations, the Contractor can finish the Day without the MTV. The Contractor shall not resume further mainline mix placement until the MTV is operational.

Consistently overloading the HMA mix into the paving machine is not Acceptable. The Contractor shall coordinate the speed of the paving machine with the production of the plant and keep enough haul Equipment available to achieve continuous operation.

The Contractor shall use the control system on the paving machine to control the grade and the transverse slope by either of the following methods:

1. One end directly and the other indirectly through controlling the transverse slope; or
2. Each end independently, including screed attachments.

The Contractor shall suspend operations if the control system does not achieve the typical section in accordance with the Plans. The Contractor shall place, spread, and finish the courses of HMA according to the following:

1. Without segregation or tearing;
2. True to the line, grade, and crown in accordance with the Plans; and
3. With self-propelled pavers, except as otherwise directed.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing Equipment impracticable, the Contractor shall dump, spread, and level the HMA by other methods to achieve the required compacted thickness.

423.3.5.1 Weather Limitations

The Contractor shall not place HMA on wet or frozen surfaces or if weather conditions prevent proper handling, finishing, and compacting. The Contractor shall place HMA when the

Chill Factor is at least 40 °F and rising. If the air temperature is 60 °F or warmer do not consider the Chill Factor.

423.3.5.2 Compaction

The Contractor shall:

1. Compact the HMA thoroughly and uniformly immediately after placement. Operate rollers at speeds slow enough to minimize displacement of the HMA, including the lines and grades of the asphalt edges. Remove marks from pneumatic rollers;
2. Prevent the HMA from sticking to the roller wheels by keeping the wheels moistened with water; water mixed with very small quantities of detergent or other approved Material. Do not use diesel fuel or other petroleum diluents;
3. At locations inaccessible to the rollers, the Contractor shall compact the HMA with hot hand tampers, smoothing irons, or mechanical tampers;
4. Use a trench roller or cleated compression strips under the roller to transmit compression to depressed areas; and
5. Remove areas that become loose, broken, mixed with dirt, segregated or defective, replace with fresh HMA, and compact to match the surrounding area, at no additional cost to the Department.

423.3.5.3 Not Used

423.3.5.4 Joints

The Contractor shall off set longitudinal joints at least six (6) inches relative to the longitudinal joints of the underlying course.

Unless otherwise specified, the Contractor shall taper transverse and longitudinal joints as follows:

1. At least a three (3) ft taper for transverse joints, with a taper slope no steeper than 24:1;
2. At least a one (1) ft taper or a notched taper, for longitudinal joints, with a taper slope no steeper than 6:1 or a notched taper with a one (1) inch vertical edge at the top of the taper connected to a slope no steeper than 6:1;
3. Cut and square off transverse tapers before commencing new Work;
4. Clean and tack coat longitudinal joints from previous operations; and
5. Avoid placing longitudinal joints in the wheel paths, unless approved by the Project Manager.

The Contractor shall completely bond joints and provide smooth surface for each course at the joints. The Department will not allow deviations greater than 3/16 inch when tested with a ten (10) ft straightedge in any direction. When paving under traffic, the Contractor shall schedule the daily surfacing operations so that tapered longitudinal joints are not exposed for longer than seven (7) Days.

423.3.5.5 Surface Tolerances

The Contractor shall provide a final HMA surfacing course that conforms to Section 401, "Pavement Smoothness Measurement."

423.3.5.6 Plan Surfacing Thickness

The Contractor shall:

1. Place pavement at the thickness specified in the Contract;
2. Monitor thickness by calculating continuous production yields using the formula found in the MT-1, as maintained by the State Materials Bureau;
3. Calculate the required yield and the corresponding yields for 0.25 inch increase (upper limit) and decrease (lower limit). The Project Manager may adjust the required yield to fit field conditions. If adjusted, the new target yield will be communicated to the Contractor in writing;
4. Control production to keep yield within the upper and lower limits;
5. Correct deficiencies at no cost to the Department;
6. Correct deficient depths during placement; and
7. Address Plan Surfacing thickness in the Quality Control Plan.

423.3.5.7 Test Strip & Shakedown Period

Prior to the Test Strip & Shakedown Period, the Contractor shall provide binder ignition oven calibration samples in accordance with the State Materials Bureau's, current *Binder Ignition Calibration Procedure*. All Quality Control, Quality Assurance and Independent Assurance ovens must be calibrated by this procedure. The Project Manager will suspend paving operations until calibration of the ovens has been completed. No additional time or compensation will be granted for completion of this requirement.

The "NMDOT Binder Ignition Calibration Procedure" is available by accessing the NMDOT website, and navigating within the Construction and Civil Rights Bureau's (CCRB) link.

The Contractor shall construct a test strip for each HMA mix design to be incorporated in the Project prior to placing the Material on mainline. The test strip will consist of a maximum of 1,000 tons, the minimum test strip size will be 500 tons or as approved by the Project Manager. The Contractor shall construct test strip on shoulders, low volume segments of the pavement, or area approved by the Project Manager.

The Contractor shall obtain a minimum of three (3) Contractor and three (3) agency samples to evaluate the JMF, process control, and placement operations. If necessary, based on the results obtained from the test strip, the Contractor shall develop a revised JMF, modify placement operations, and/or implement adjustments to process control procedures. Production and placement operations performed prior to approval of a revised JMF are at the Contractor's risk.

The test strip will be evaluated for Acceptance according to Table 423.3.5.7:1, "Test Strip Acceptance Limits." If Accepted, the test strip will be paid at the unit price for HMA Complete or HMA per Section 423.5, "Basis of Payment." If rejected, said Material shall be handled in accordance with Section 423.3.6.3.2, "Adherence to Specifications and Rejection of Non-Specification Material." The Contractor shall remove rejected test strip Material placed within the Roadway Prism at no cost to the Department. If the Contractor disagrees with removing and replacing unacceptable Material placed in test strips outside the Roadway Prism, the Assistant District Engineer for Construction, based on engineering judgment, will decide if the Material can remain in place with a maximum pay factor of 50%, or shall be removed and replaced at no cost to the Department.

If the test strip is rejected, the Contractor shall construct a subsequent test strip. The Contractor shall not proceed to full production until an Accepted test strip is produced. After the test strip is Accepted, the Contractor shall continue to evaluate the mix properties and the JMF during the placement of the first two (2) sublots in the first lot. Changes may be made to the JMF or the mix proportions and/or properties with the concurrence of the State Materials Bureau, Project Manager, and Assistant District Engineer for Construction. For changes made prior to the completion of the first two (2) sublots, the adjustments will be applied to the entire lot for purposes of payment.

The Project Manager may waive test strip requirements for the Project, if requested by the Contractor based on prior experience with the JMF.

The Shakedown Period is defined as the first two (2) sublots produced in the first lot.

As the test strip is placed, the Contractor shall evaluate the mix properties and the JMF. Changes may be made to the JMF or the mix proportions and/or properties with the concurrence of the State Materials Bureau, Project Manager, and the Assistant District Engineer for Construction.

**Table 423.3.5.7:1
Test Strip Acceptance Testing Limits ^{a,c}**

Characteristic	Allowable Tolerances from TV
Air Voids, %	± 2.0
Pavement Density % ^c	90% to 97%
Mineral Admixture %	±0.2%
Voids in the Mineral Aggregate (VMA), % ^a	± 2.0
Asphalt Content % ^{a,b}	± 0.50

^a Asphalt Content will be determined using AASHTO T308 as modified by TTCP.

^b HMA will not be rejected based on Asphalt Content Determined by AASHTO T 308.

^c Acceptance will be based on the average test values.

423.3.6 Sampling and Testing

The Contractor shall sample and test in accordance with Section 901, "Quality Control Quality Assurance General Provisions," and Section 906, "Minimum Testing Requirements." The Department will sample and test in accordance with Section 901, "Quality Control /Quality Assurance General Provisions," and Section 906, "Minimum Testing Requirements."

423.3.6.1 Contractor Quality Control

The Contractor shall administer a Quality Control Plan, referred to hereafter as "the Plan". The Contractor shall ensure the Plan conforms to Section 902, "Quality Control." The Contractor shall submit the Plan a minimum of two (2) weeks prior to commencement of crushing operations and at a minimum comply with "Contractor Quality Control Plan Guidelines." No HMA operations are allowed until the Plan has been approved by the Project Manager and the District Lab Supervisor. The Contractor shall sample and test the mixture and pavement on a statistically random basis in accordance with Section 906, "Minimum Testing Requirements."

423.3.6.1.1 Contractor Quality Control of Aggregate

The Contractor shall obtain samples in accordance with Section 902.5, "Sampling."

The Project Manager may sample and test the aggregate at any time during production or stockpiling, or may request to split samples with the Contractor.

423.3.6.1.2 Contractor Quality Control for Compaction

The Contractor shall:

1. Monitor the compaction process by determining the density of the HMA with a portable densometer in accordance with the Plan;
2. Establish calibration of the portable densometer from cut pavement samples;
3. Determine the density readings of the cut pavement samples in accordance with AASHTO T 166 (weight, volume method); determine the density readings of the pavement with the portable densometer and correlate these test results;
4. Conduct Quality Control testing in accordance with Division 900, "QUALITY CRITERIA" and provide test results to the Project Manager;
5. Perform Quality Control density testing while the asphalt mixture is hot enough to permit further compaction;
6. Not roll for compaction when it becomes ineffective or damages the HMA; and
7. Not use vibratory mode when it becomes ineffective or damages the HMA.

423.3.6.2 Department Quality Assurance

The Department will sample and test the mixture and pavement on a statistically random basis in accordance with Section 906, "Minimum Testing Requirements."

423.3.6.3 Acceptance

The Department will evaluate Materials using Contractor and Department test data from each Random sampling Plan for Acceptance in accordance with this section.

**Table 423.3.6.3:1
Acceptance Testing Tolerances^a**

Characteristic	Specification limit, percentage points from TV
Air Voids, %	± 1.4
Pavement Density % ^c	± 2.5
Mineral Admixture% ^e	Minimum of JMF Target Value
Voids in the Mineral Aggregate (VMA), % ^{a,d}	± 1.6
Asphalt Content % ^{a,b}	± 0.50

^a All gradation, Asphalt Content, VMA, and VFA values shall be determined using the AASHTO T 308 testing results.

^b HMA will not be rejected based on Asphalt Content Determined by AASHTO T 308.

^c Density payment will be adjusted in accordance with Section 901.3.11, "QLA."

^d If Gmm fluctuates more than ±0.03 on a consistent basis, it is recommended that the Specific Gravity of the aggregates be checked in order to verify VMA.

^e If Mineral Admixture is below Design TV cease hot mix production, investigate and correct.

Department personnel may test locations other than the random locations generated for statistical analysis. These tests will not be used for pay factor determination, but may be used to determine Acceptance or rejection of localized Material.

423.3.6.3.1 Quality Level Analysis (QLA)

The Department will determine Acceptance of the Materials in accordance with Section 904, "Quality Level Analysis (QLA)," using the Acceptance limits in Table 423.3.6.3, "Acceptance Testing Tolerances." Acceptance lot sizes shall be determined at the Pre-Paving Conference. The Department will have the final authority for determination of Acceptance lot size. For all QLA Projects, if a composite pay factor of more than one (1.00) is calculated, the composite pay factor will be a one (1.00) for the purposes of payment.

423.3.6.3.1.1 Acceptance of Pavement Density

The target density for Acceptance of HMA will be 94.50% of the theoretical maximum density as determined from AASHTO T 209. For determination of maximum specific gravity, the Contractor shall obtain and test a minimum of two (2) samples and ensure the Department obtains and tests a minimum of one (1) sample for each Day that the HMA is placed, in accordance with the random sampling Plan. Each individual density test value obtained less than 92.0% or more than 97.0% of the theoretical maximum density will be evaluated in accordance with Section 423.3.6.3.2, "Adherence to Specifications and Rejection of Non-specification Material."

For purposes of Acceptance and pay factor determination:

1. Determine the density from cut pavement sections (cores) with six (6) inch diameters extending through the full thickness of the HMA;
2. Determine the pay factor in accordance with Section 904, "Quality Level Analysis;"
3. To be prepared for dispute resolution, the Contractor shall provide one (1) additional core for each core tested by the Department for Acceptance of density in accordance with section 423.3.7, "Dispute Resolution;" and
4. If a composite pay factor of more than one (1.00) is calculated, the composite pay factor will be a one (1.00) for the purposes of payment.

For Projects consisting of single lift overlays or mill and inlay with a single lift of two and a half inches or less, the Project Manager may grant an exception to the mean density target requirement of at least 94.5% of the theoretical maximum density if the Contractor can demonstrate that a minimum of 92.0% cannot be reasonably obtained because of the existing conditions of the Pavement Structure or Subgrade Materials. The Contractor demonstrates this by providing non-destructive density results obtained during paving operations witnessed by a State Inspector at the location in question. If the Project Manager grants this exemption, the Contractor shall construct a Roadway test strip and develop an HMA compaction process to get the highest possible density based on an approved roller's density gain per pass, in accordance with Section 423.3.4.4, "Compaction Equipment." The Project Manager will approve the process, establish a new target value for density and establish a new Acceptance lot only for the portion of the Project addressed herein (except for the Roadway test strip) before paving begins or continues. Lot density shall not fall below 91%. If a lot does not meet either of the revised density requirements, the Project Manager will, with the concurrence of the Assistant District Engineer for Construction do the following:

1. Accept and pay for the lot of HMA at 50% of the Bid Item Unit Price; or
2. Reject the in-place Material and require the Contractor to remove and replace at no cost to the Department.

423.3.6.3.2 Adherence to Specifications and Rejection of Non-Specification Material

The Contractor shall produce Material in substantial compliance with all Specification requirements. The Department will evaluate Air Voids, Pavement Density, Void in Mineral Aggregate (VMA), and Asphalt Content test results for Specification compliance. Evaluation of Material that does not meet Specifications will be in accordance with the following:

Individual Test Results. If an individual test is outside the Specification limits but is less than two (2) standard deviations from the mean of previously produced Material of the current lot, investigate and propose corrective actions but production may continue and the result will be entered into QLA. If an individual test result (for the current lot) is outside the Specification limits and is two (2) or more standard deviations from the mean of previously produced Material, the Contractor shall cease production, investigate the causes of the failure, and propose corrective actions. The Contractor shall not resume production until the proposed corrections are approved by the Project Manager.

Consecutive Test Results. If two (2) consecutive test results of the same property (for the current lot) are outside the Specification limits, cease production, investigate the causes of the failure, and propose corrective action. The Contractor shall not resume production until the proposed corrections are Accepted by the Project Manager in writing. Limit production to a maximum of 1,000 tons, production will include a minimum of two (2) Contractor tests and one (1) Department test. If testing indicates that the problem has been corrected, the Contractor shall resume full operations. If the problem has not been corrected, the Contractor shall perform further trial runs and testing.

Pavement Density Below 90.000%. All pavement density tests that are below 90.000% are rejected and the Contractor shall remove and replace all Material represented by the test with Specification Material at the Contractors expense. The Contactor shall submit a Plan in writing for approval by the Project Manager that determines the limits of Material to be removed within 48 hours of reporting a Quality Control test or receiving a Quality Assurance test for pavement density below 90.000% density. If the test below 90.000% is a Department test, the Department will obtain a new test from the Material replaced by the Contractor to replace the density test reported by the Department. If the test below 90.000% is a Contractor test, the Contractor shall obtain a new test from the Material replaced by the Contractor to replace the test reported by the Contractor. The test obtained from the replaced Material will be input into the QLA to replace the test below 90.000%.

All Material that is rejected, at the sole discretion of the Department, shall be removed and replaced with Specification Material at the Contractor's expense. If the Material is allowed to remain in place by the Department all random, sample data will be entered into QLA, this does not apply to pavement density below 90.000% that shall be removed and replaced. Sampling for corrective action will not be entered into QLA.

The Project Manager may reject Material that appears to be defective based on visual inspection.

423.3.6.4 Independent Assurance Testing

The Department will perform Independent Assurance sampling and testing in accordance with Section 906, "Minimum Testing Requirements."

423.3.7 Dispute Resolution

For any test incorporated into the pay factor, if a dispute exists the Project Manager and Contractor will investigate to determine why and make corrections if possible. If the

discrepancy cannot be resolved, then either party may invoke the dispute resolution process. The State Asphalt Engineer will maintain a list of labs that are willing and capable of performing referee testing. All referee Labs shall be AASHTO Materials Reference Laboratory (AASHTO RE: SOURCE) certified for the test(s) to be performed. Neither the Department's Project staff, nor the Contractor will know who is performing the referee testing. The State Asphalt Engineer will select a Laboratory, without disclosing the name of the Lab to Department Project personnel or Contractor personnel, from the following, not in priority order:

1. A District Laboratory not from the District in which the Project resides;
2. A Laboratory currently listed on the State Material's Bureau's list of approved testing labs not involved in the subject Project in any manner, such as mix design submittal, preliminary testing for design, etc. Only Laboratories that are in the routine business of providing testing and designs will be considered; or
3. State Materials Bureau Laboratory.

For all testing incorporated into the pay factor, an additional sample from the Department's Acceptance Samples and the Contractor's Quality Control Samples shall be obtained for referee testing purposes. Failure to provide the referee samples will result in the Project Manager suspending the Project at no cost to the Department. Additional time will not be added to the Contract for Project suspension caused by failure to comply with Dispute Resolution Process. Work shall not resume until the Contractor provides the sample(s) and satisfies the Project Manager, in writing, that future samples will be provided in compliance with this requirement. The referee sample(s) is (are) to be retained by the Department. The Department will retain the referee samples at a location determined by the Project Manager. Once the pay factor is determined, the Contractor shall dispose of the unused samples at no cost to the Department. In no case will the unused samples be disposed of prior to the ten (10) Calendar Day period in which the Dispute Resolution process may be invoked.

For Pavement Density, the additional core(s) will be stored and retained in a location approved by the Project Manager. Should the Dispute Resolution Process for Density be invoked, the additional core will be provided to the Referee Lab per the NMDOT REFEREE TESTING POLICY. The original density value obtained will be replaced by the data obtained from the Referee Lab result.

When a referee Lab is used, the referee Lab's test results will be used in determining the pay factor. The request to referee must be invoked in writing within ten (10) Calendar Days of receiving the test results from the other party. If not invoked within ten (10) Calendar Days, the test results are deemed Accepted. The test results from the referee Lab will replace the Department's or the Contractor's test results for the sample in question. If the composite pay factor decreases from applying the referee Lab's results, the Contractor shall pay for the testing performed by the referee Lab. If the composite pay factor increases from applying the referee Lab's results, the Department will pay for the testing performed by the referee Lab. If the composite pay factor remains unchanged, the cost shall be split with each party responsible for 50% of the total cost.

The "NMDOT REFEREE TESTING POLICY" will be used to coordinate the efforts of managing Dispute Resolution by both the Department and Contractor. This policy is made available by accessing the NMDOT website, and navigating within the Construction and Civil Rights Bureau's (CCRB) link.

Failure to comply with the requirements contained herein will result in the pay factor being calculated in accordance with the applicable Sections of 423, "Hot Mix Asphalt (HMA) (Major Paving) and 904, "Quality Level Analysis" and no test results will be replaced by referee results.

423.4 METHOD OF MEASUREMENT

If the Department measures *HMA* by the square yard, the Department will use the average width of the HMA in place and the length from station to station along the centerline of the Roadway when calculating quantities.

423.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>HMA Complete</i>	Ton or Square Yard
<i>HMA</i>	Ton or Square Yard

The Department will pay for Accepted quantities at the Bid Item Unit Price, adjusted in accordance with Section 423.5.1, "Price Adjustments." Providing and transporting all cores, samples and storage containers shall be Incidental to the Pay Items above.

423.5.1 Price Adjustments

The Department will pay for Accepted quantities of *HMA* or HMA Complete at the Bid Item Unit Price, adjusted in accordance with Section 904, "Quality Level Analysis (QLA)." The HMA will be evaluated on a lot-by-lot basis at a price determined by multiplying the Bid Item Unit Price by the weighting factor. The Department will use Table 904.1:1, "Weighting Factors," to calculate each lot's composite pay factor. The pay factor for the entire Project will be calculated by applying weighted averages, based on tonnage contained within each lot, to each lot's composite pay factor. If the composite pay factor for a lot is greater than one (1.0), the pay factor will be set at one (1.0).

423.5.2 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Asphalt binder, aggregate, blending sand, mineral filler, mineral admixture, and WMA additive or process as appropriate;
2. Mixing, hauling, placement, and compaction of HMA or WMA;
3. Quality Control in accordance with Section 902, "Quality Control;"
4. Providing and transporting all cores for correlation;
5. Providing Mix Design in accordance with Section 423.2.8, "Mix Design;" and
6. Providing storage container for samples and cores if referee testing is used.

SECTION 424: WARM MIX ASPHALT (WMA) (MAJOR PAVING)

424.1 DESCRIPTION

This Work consists of constructing one (1) or more pavement courses of Warm Mix Asphalt (WMA) on a prepared base milled surface.

WMA shall be produced in a mixing plant and stored, hauled, placed and compacted in accordance with the requirements of this Section and as shown in the Contract.

Section 423, "Hot Mix Asphalt – Superpave (Major Paving)" shall be complied with except as modified herein.

424.1.1 Definition

Warm Mix Asphalt (WMA) is a generic term used to describe the reduction in production paving and compaction temperatures achieved through the use of one (1) of the approved WMA Technologies.

Some modification to WMA plants may be necessary to accommodate the WMA Technologies as noted in Section 424.3, "Construction Requirements."

424.2 MATERIALS

424.2.1 General

WMA may be produced by one (1) or a combination of several technologies which may include WMA plant foaming processes and Equipment, mineral additives or chemicals that allow the reduction of the production temperatures.

WMA is a mixture of asphalt binder, Warm Mix Additive (or technologies), aggregate, blending sand, mineral filler, and mineral admixture Material. The warm mix additive, or technology, shall be approved by the Department and included in the most current Approved Products List (APL). Unless otherwise prohibited in the Contract, the Department will allow Recycled Asphalt Pavement (RAP) in WMA mixes as long as the resulting mixture conforms to all Specification requirements.

A technical representative of Warm Mix Additive Supplier, including contact information shall be designated in writing via the mix design submittal process. The representative is expected to ensure that the Warm Mix Additive is handled properly. The representative does not have the authority to allow any deviation from the Department Specifications and Project requirements.

424.2.2 Aggregate

Refer to Section 423.2.2, "Aggregate."

Note: HMA will be replaced with WMA.

424.2.3 Asphalt Binder

Refer to Section 423.2.3, "Asphalt Binder."

424.2.3.1 Warm Mix Additive or Technology

Only Warm Mix Additives or Technologies approved by the Product Evaluation Program and listed on the NMDOT Approved Products List (APL) can be used on Department Projects.

To be placed on the APL, the WMA additive Supplier shall verify that the binder with the additive meets the PG grade of the specified binder. The potential additive Supplier shall demonstrate this to the Department by evaluating the Asphalt Binder containing the WMA additive at the expected additive dosage rates for compliance with the specified PG grade in accordance with AASHTO M320, Table 1 and Section 402.2.2.1.1, "Performance Graded Asphalt Binder."

The type and dosage rate of Warm Mix Additives shall comply with the recommendations of the Warm Mix Additive Supplier. Warm Mix Additive dosage rates shall not deviate from those recommended by the Warm Mix Additive Supplier. If a terminal blend Warm Mix Additive is used, the dosage rate shall be shown on the Materials Certificate of Compliance.

After the Warm Mix Additive is introduced, the PG grade of the binder shall comply with the PG grade as specified in the Contract.

For foamed asphalt systems, only foam systems that approved by the State Asphalt Engineer shall be used. Foamed asphalt systems, are not part of the NMDOT APL.

424.2.4 Mineral Admixtures

Refer to Section 423.2.4, "Mineral Admixture."

424.2.5 Blending Sand

Refer to Section 423.2.5, "Blending Sand."

424.2.6 Mineral Filler

Refer to Section 423.6, "Mineral Filler."

Note: HMA will be replaced with WMA.

424.2.7 Reclaimed Asphalt Pavement

Refer to Section 423.2.7, "Reclaimed Asphalt Pavement."

Note: HMA will be replaced with WMA.

424.2.8 Mix Design

Refer to Section 423.2.8, "Mix Design."

Note: HMA will be replaced with WMA.

In addition to the above reference, the Contactor shall provide documentation confirming the WMA additive or technology blended with the asphalt binder results in asphalt cement that meets the specified PG Grade Asphalt Binder.

The WMA Additive or Technology Supplier and the Asphalt Binder Supplier will recommend mixing, compaction, and maximum allowable temperatures to be used for the development of the mix design.

424.2.9 Job Mix Formula

Refer to Section 423.2.9, "Job Mix Formula."

424.3 CONSTRUCTION REQUIREMENTS

424.3.1 General

Refer to Section 423.3.1, "General."

Note: HMA will be replaced with WMA.

424.3.2 Mix Temperature Requirements

The Contractor shall not allow the temperature of the WMA to be less than 215 degrees F or greater than 275 degrees F behind the laydown machine. WMA delivered to the Project with mix temperatures outside the Acceptable range shall, at the sole discretion of the Project Manager, be removed and replaced at no cost to the Department.

424.3.3 Addition of Mineral Admixtures

Refer to Section 423.3.3, "Addition of Mineral Admixture."

424.3.4 Equipment

Refer to Section 423.3.4, "Equipment."

Note: HMA will be replaced with WMA.

The Contractor shall use Equipment and WMA technologies capable of producing an asphalt mixture that meets Specification requirements and is workable at the minimum placement and compaction temperatures desired, regardless of storage or haul distance considerations.

424.3.4.1 Mixing Plants

The Contractor shall modify the asphalt mixing plant as required by the manufacturer to introduce the WMA technology.

424.3.4.1.1 Plant Scales

Refer to Section 423.3.4.1.1, "Plant Scales."

In addition to the above reference, the Contractor shall modify the asphalt mixing plant as required by the manufacture to introduce the WMA additive or technology.

424.3.5 Placement Operations

Refer to Section 423.3.5, "Placement Operations" except the following subsections as modified herein.

Note: HMA will be replaced with WMA.

424.3.5.1 Weather Limitations

The Contractor shall not place WMA on wet or frozen surfaces or if weather conditions prevent proper handling, finishing, and compacting. The Contractor shall place WMA when the Chill Factor is at least 35 °F and rising. If the air temperature is 55 °F or warmer, the Contractor shall not consider the Chill Factor.

424.3.6 Sampling and Testing

Refer to Section 423.3.6, "Sampling and Testing."

Note: HMA will be replaced with WMA.

In addition to the above referenced section the following shall be complied:

If the WMA additive Supplier indicates that the additive makes mix properties time defendant; the Plan must include how all of the required testing will be completed in the designated time frame. This Plan will include how the Contractor will comply with the required testing within the Supplier's specified time frames. It will also include how the Department will be supported, if necessary, to complete their tests within the time frame required if the testing cannot be performed at Department established facilities. This Plan must be reviewed and approved by the Project Manager and by the District Laboratory Supervisor prior to the placed of any WMA on the Project. If the Job Mix Formula changes, it shall be addressed in conformance with Section 423.2.9.1, "Job Mix Formula Adjustments."

424.3.7 Dispute Resolution

Refer to Section 423.3.7, "Dispute Resolution."

Note: HMA will be replaced with WMA.

424.4 METHOD OF MEASUREMENT

If the Department measures WMA by the square yard, the Department will use the average width of the WMA in place and the length from station to station along the centerline of the Roadway when calculating quantities.

424.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>WMA Complete</i>	Ton or Square Yard
<i>WMA</i>	Ton or Square Yard

The Department will pay for Accepted quantities at the Bid Item Unit Price, adjusted in accordance with Section 424.5.1, "Price Adjustments." Providing and transporting all cores, samples and storage containers shall be Incidental to the Pay Items above.

424.5.1 Price Adjustments

Refer to Section 423.5.1, "Price Adjustments."

Note: HMA will be replaced with WMA.

424.5.2 Work Included in Payment

Refer to Section 423.5.2, "Work Included in Payment."

SECTION 450: PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) (QLA)

450.1 DESCRIPTION

This Work consists of constructing Portland Cement Concrete Pavement (PCCP) on a prepared Subgrade, Base Course or HMA/WMA.

450.2 MATERIALS

Portland cement, air-entraining admixtures, chemical admixtures, mineral pozzolans, water, and aggregate will meet the requirements of Section 509, "Portland Cement Concrete."

450.2.1 Dowels and Tie Bars

Dowels and tie bars will meet the applicable requirements of Section 540.2, "Steel Reinforcement Materials."

450.2.2 Joint Sealing Material

Joint sealing Material will meet the requirements of Section 452, "Sealing and Resealing Concrete Pavement Joints."

450.2.3 Curing Compound

The Contractor shall use curing compound that complies with the requirements of ASTM C309 for Type 1-D or Type 2.

450.3 CONSTRUCTION REQUIREMENTS

450.3.1 Proportioning

The Contractor shall use a Class P concrete mix that has been reviewed and approved in accordance with Section 509, "Portland Cement Concrete Mix Designs" by the State Concrete Engineer. If the concrete is not slip-formed, an approved Class HPD concrete mix shall be used instead of Class P.

The Contractor shall mix and place all concrete in accordance with Section 510.3, "Construction Requirements" except for Subsection 510.3.5.5, "Price Adjustments." The Contractor shall use a concrete mix that has been approved for use in the Freeze-Thaw zone, as defined in Section 509.2.7.4, "Freeze-Thaw Risk Zones" in which the Project is located.

The Contractor shall keep a copy of the approved mix design available on the jobsite when using the concrete mix.

450.3.2 EQUIPMENT

450.3.2.1 Batching Plant

The Contractor shall Use batching plants and Equipment that meet the requirements of Section 510.3.2.1, "Batching Plant."

450.3.2.2 Mixers

The Contractor shall use mixers that meet the requirements of Section 510.3.2.6, "Mixing."

450.3.2.3 Transporting

The Contractor shall use truck mixers, truck agitators or non-agitating trucks that comply with Section 510.3.2, "Transporting."

450.3.2.4 Slip-Form Paver

The Contractor shall place the concrete with an approved slip-form paver designed to spread, consolidate screed, float, and finish the concrete in one (1) complete pass to create a dense and homogeneous pavement. Minimize the use of hand finishing.

The vibrators of the slip-form paver must be located behind the auger. The Contractor shall not use pavers with vibrators in front of the auger.

The Contractor shall equip slip-form pavers with internal vibrators that meet or exceed the following Specifications at 8,000 cycles per minute (cpm) under no-load conditions:

1. Amplitude (peak to peak) = 0.070 inch; and
2. Centrifugal force = 1,200 lb.

The Contractor shall equip the slip-form paver with an electronic monitoring device capable of the following:

1. Displaying the operating frequency of each internal vibrator; and
2. Continuously recording at a minimum the following:
 - a. Time of Day,
 - b. Station location,
 - c. Paver track speed, and
 - d. Operating frequency of each vibrator.

The Contractor shall store all information captured by the electronic monitoring system throughout the Project. This information is to be used only for Project information by the Department and will be provided to the Project Manager at his request during the course of the Project and at the completion of the Project.

The Contractor shall position the vibrators no further apart than the manufacturer's recommendations for horizontal spacing of the vibrators; but do not exceed 18 inches, center-to-center. The Contractor shall ensure that the space from the outer edge of the pavement to the center of the outside vibrator does not exceed nine (9) inches, or ½ the maximum recommended spacing, whichever is less.

450.3.2.5 Concrete Jointing Equipment

The Contractor shall provide enough sawing Equipment to complete the Work within the allotted time. The Contractor may use a water-cooled diamond edge saw blade, or an "early entry dry cut" type with a skid plate, as defined by ACI 302. The Contractor shall provide at least one (1) additional saw in good working order. The Contractor shall keep an ample supply of saw blades (and skid plates, if the "early entry dry cut" saws are used) at the Work site during sawing operations.

450.3.2.6 Curing Compound Application Equipment

The Contractor shall apply curing compounds with Equipment that uses a pressure tank or pump. The Contractor shall ensure that the Equipment has a feed tank agitator that provides continuous agitation of the compound during spraying operations. The Contractor shall use a nozzle that contains enough air to thoroughly atomize the compound.

450.3.3 Operations

For slip-form paving, the Contractor shall construct a padline of sufficient width and stability to accommodate the slip-form paving Equipment.

The Contractor shall provide enough lateral support to construct the section in accordance with the Contract. The Contractor shall maintain the smoothness and compaction of the Base Course in the specified condition until the concrete placement is completed. The Contractor shall moisten untreated aggregate base layer, if used, before paving standing water will not be allowed.

The Contractor shall control the paver alignment and grade by using a string line pulled from pin to pin in front of the paver at intervals not greater than 25 feet, or by automatic machine control (stringless system).

450.3.3.1 Handling, Measuring, Batching, and Mixing Materials

The Contractor shall handle, measure, batch, and mix the Materials in accordance with Section 510, "Portland Cement Concrete." The maximum mixing time for either truck mixers or non-agitating mixers is specified in Section 510.3.4.2, "Mixing Time."

450.3.3.2 Placing, Spreading, and Consolidating Concrete

The Contractor shall place concrete with the specified thickness along the full width of the lane or area being paved. The Contractor shall prevent segregation and minimize redistribution. The Contractor shall place the concrete continuously between transverse joints without using intermediate bulkheads.

When using dowel baskets, the Contractor shall not end-dump the concrete directly onto the dowel baskets. The Contractor may use end-dumps to transfer the concrete to the Equipment designed to place it completely across the grade. The Contractor shall not windrow the concrete.

When placing concrete adjacent to a newly constructed PCCP lane, the Contractor shall not operate Equipment or traffic on the lane until the concrete has achieved a compressive strength of at least 3,000 psi, as determined by the Maturity Method, as described in Section 510.3.5.2, "In-Place Concrete Strength Measurements."

When working on existing pavement, the Contractor shall use Equipment with protective pads on crawler tracks or rubber-tire wheels. The Contractor shall set the crawler tracks or rubber-tire wheels far enough from the pavement edge to prevent damage to the pavement.

The Contractor shall receive delivery tickets, monitor and maintain yield to achieve the minimum required thickness. Copy of tickets shall be delivered to NMDOT at the end of each Days paving.

Additional concrete Material shall be placed at locations of grade adjustments and irregularities as approved by NMDOT.

450.3.3.2.1 Slip-Form Paving

The Contractor shall use a slip-form paver that complies with Section 450.3.2.4, "Slip-Form Paver" to distribute the concrete uniformly. The Contractor shall vibrate the full width and depth of the concrete to consolidate the concrete without causing segregation. The Contractor shall ensure that the vibration produces uniform concrete that will stand normal to the surface with sharp well-defined edges.

The Contractor shall coordinate concrete mixing, delivering, and spreading operations in order to provide uniform progress and to minimize stopping and starting of the paver. If it is necessary to stop the paver, the Contractor shall also stop the vibratory and tamping elements immediately. The Contractor shall not apply external tractive force to the machine; the machine must be propelled only by its own mechanisms.

450.3.3.2.2 Other Paving

For paving operations that are not slip-formed, the Contractor will place Class HPD concrete between stationary side forms. The Contractor shall consolidate the concrete by internal vibration and finish it to the required surface smoothness using the hand-float method or other suitable means. The Contractor shall cure the concrete with approved methods.

The Contractor shall leave wood or metal forms in place at least 12 hours after placing the concrete. If necessary, the Contractor shall take additional efforts to prevent thermal cracking of the concrete. The Contractor shall clean and oil the forms each time they are used. The Contractor shall apply a curing compound to the concrete surfaces exposed by removal of the forms immediately after removing the forms.

The Contractor shall check the form's alignment and grade elevations and make the necessary corrections before placing the concrete. If a form is disturbed or if the Base Course under a form becomes unstable, the Contractor shall reset and recheck the form, as directed by the Project Manager.

450.3.3.3 Temperature and Weather Limitations

Temperature and weather limitations are defined in Section 511.3.4, "Temperature and Weather Limitations." The Contractor shall keep the concrete temperature between 50 °F to 90 °F at the time of placement. For cold weather placement refer to Section 511.3.3.1, "Cold Weather Concrete." The Contractor shall provide the Project Manager with Hot Weather and Cold Weather Concrete Placement and Curing Plan(s) in accordance with Section 51.3.4, "Temperature and Weather Limitations" for review and approval by the State Concrete Engineer.

450.3.3.4 Rate of Evaporation Limitations

The Contractor shall continuously monitor the evaporation potential at a height not to exceed five (5) ft above the surface of the concrete as determined from Figure 511.3.4.3:1, "Surface Evaporation from Concrete" at the actual placement location. Computerized Equipment furnished by the Contractor must have the capability to automatically take the required readings. Readings shall be taken at least once every five (5) minutes beginning at least 15 minutes before the placement begins and continuing until the final application of the curing compound has been completed. All readings shall be graphically plotted on a continuous time scale.

The Contractor shall not place (or continue to place) PCCP if the average evaporation potential over any ten (10) minute period of time is greater than 0.2 lb per square ft per hour.

If the evaporation exceeds the 0.15 lb per square foot per hour, one (1) or more of the following actions shall be implemented to reduce the rate of evaporation, as approved by the Project Manager:

1. The Contractor shall use an evaporation retarder (If used, this cannot be used as a finishing aid).
2. The Contractor shall erect windbreaks to reduce the wind velocity over the concrete surface.
3. The Contractor shall place concrete during nighttime or early morning hours.
4. The Contractor shall lower the fresh concrete temperature during hot weather. This can be accomplished by using cool aggregate and chilled water, by adding ice as part of the mixing water, or by adding liquid nitrogen to the concrete mix after all mix ingredients have been placed into the ready mix truck.
5. The Contractor shall increase the relative humidity at the site with a fog spray maintained over the entire concrete surface until the final finish has been achieved and the curing system has been applied.

450.3.3.5 Change in Atmospheric Conditions

Placement of any PCCP by the Contractor during marginal weather placement is at the Contractor's risk. The Contractor shall repair or replace at no additional cost to the Department any concrete that is determined by the Assistant District Engineer (Construction) to be damaged due to weather conditions.

450.3.4 Joints

The Contractor shall submit the proposed joint layout plan in .pdf format to the Project Manager, State Pavement Engineer, and the State Materials Bureau for review and approval at least four (4) weeks before starting concrete slab construction. The proposed joint layout plan shall have the lane markings clearly depicted. Attempts shall be made in the submitted jointing plan for mainline paving not to place longitudinal joints in the wheel path. After receiving the recommendations and/or responses from the State Pavement Engineer and from the State Materials Bureau the Project Manager will either approve or reject the submittal within ten (10) Working Days from the date of submittal.

The Contractor shall construct joints at the locations, intervals, and dimensions shown in the approved joint layout Plan, and seal them in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints." The Contractor shall ensure no re-entrant corners. For typical slabs, the longitudinal joint spacing shall not exceed 12 feet and the transverse joint spacing shall not exceed 15 feet.

The Contractor shall avoid taper joints if possible. If a tapered joint is formed, the Contractor shall place a control joint at:

1. One-half the distance between the end of the taper and the opposite end, if the baseleg is less than or equal to ten (10) ft and longer than five (5) ft; or
2. Third points along the base leg, if the base leg is longer than ten (10) ft.

Additional Jointing Guidance:

1. No slabs will have angles less than 60 degrees.
2. Joints shall be "dog-legged" through curve radius points. Dog leg should be at least 24 inches in length to the radius point.
3. The Contractor shall construct joint faces perpendicular to the PCCP surface.

The Contractor shall install dowels at any joints added to control cracking in exactly the same way as the standard joints.

The Contractor shall construct transverse and longitudinal contraction joints by inserting control joints while the concrete is still plastic or by sawing the freshly hardened concrete as soon as possible after placing it. The Contractor shall make the initial sawcut at least one third the pavement depth. The Contractor shall not allow the saw to cut so deep that any reinforcement is damaged.

The Contractor shall saw joints in a sequence and with a timing that will eliminate the possibility of uncontrolled cracking.

Time to cut longitudinal and transverse joints is to be determined by the Contractor. Approval of jointing Plan by NMDOT does not absolve the Contractor from responsibility of PCCP panels containing uncontrolled cracks. The Project shall not be granted Substantial Completion until all panels containing cracks have been removed and replaced.

The Contractor shall make transverse contraction and longitudinal joints in two (2) phases. The Contractor shall make the initial saw cut or inserted joint wide enough and deep enough to ensure that a sufficiently weakened cross-section exists, but not less than 1/3 the thickness of the concrete. The Contractor shall make the second sealant reservoir-shaping saw cut in accordance with the details shown in the Plans. The Contractor shall not damage the steel reinforcement with any saw cut.

The Contractor shall saw joints sequentially. However, the Contractor may saw control transverse joints at intervals shown in the Contract, or at intervals that will most effectively minimize the possibility of uncontrolled cracking.

If necessary, the Contractor shall perform the sawing operations day and night, regardless of weather conditions. The Contractor shall not saw a joint if a crack occurs at or near the joint location before sawing. The Contractor shall immediately discontinue sawing of a joint when a crack develops ahead of the saw.

The Contractor shall install dowels at transverse construction joints.

The Contractor shall construct transverse contraction joints by sawing the freshly hardened concrete as soon as possible after placement. The Contractor shall make the saw cut at least one third (1/3) the pavement depth as shown on the typical drawing included in the Project documents, or 1 1/4 inch depth for early entry sawing. The Contractor shall not allow the saw to cut so deep as to damage any reinforcement.

All PCCP panels containing full-depth uncontrolled cracks shall be removed and replaced at no additional cost or time to the Department. The Project shall not be granted Substantial Completion until all panels containing full-depth cracks have been removed and replaced.

The Contractor shall change saw blades (and skid plates, when using the early entry dry cut saws) as often as required to control and minimize spalling. The Contractor shall maintain a sufficient supply of replacement saw blades and skid plates at the Project site to insure that the sawing operations will proceed without interruption until completed.

450.3.4.1 Longitudinal Joints

The Contractor shall place tie bars in accordance with the current NMDOT Standard Drawings, perpendicular to the longitudinal joints using approved Equipment, or secure the

joints with chairs or baskets. The Contractor shall not place tie bars within 15 inches of transverse joints.

The combined width of all concrete slabs tied together in any one (1) placement shall not be more than 40 feet.

The Contractor shall use straight full-length tie bars, a two (2) part threaded tie bar and splice coupler system, or bent tie bars. The Contractor shall only bend tie bars made of Grade 420 steel. The Contractor shall bend tie bars at right angles against the form of the first lane constructed and then straighten them into final position before placing the concrete of the adjacent lane.

If construction of PCCP abuts existing pavement, the Contractor shall drill the holes at mid-depth of the thinner slab. The Contractor shall drill the face of the existing PCCP to accept half of the tie bar length. The Contractor shall ensure that the drill holes are a diameter that allows easy insertion of the tie bar but minimizes the requirement for grout or epoxy anchor Materials. The Contractor shall construct joints with tie bars as shown on the Plans.

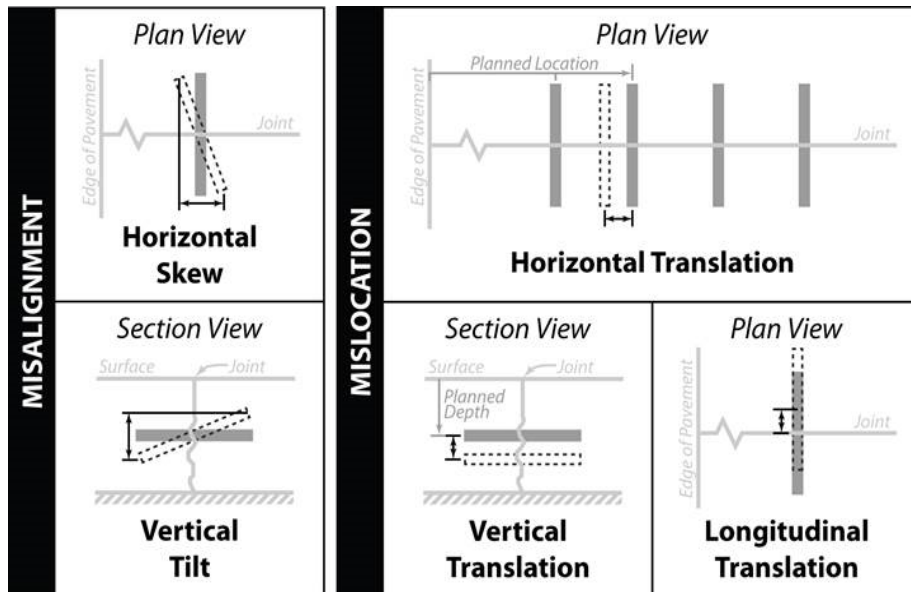
450.3.4.2 Transverse Joints

The Contractor shall construct transverse contraction joints with load transfer devices (dowels). The Contractor shall hold dowels in position parallel to the surface and centerline of the slab with chairs or other approved supports as approved by the Project Manager. The Contractor shall submit shop drawings of the welded dowel assemblies to the Project Manager for approval by State Pavement Engineer. The Contractor shall not place concrete until the Department approves the welded dowel assemblies.

Dowel bars shall be installed within the tolerances and of the size, grade and spacing specified. Horizontal support wires or shipping braces shall be non-deformed bars or wires with a diameter less than or equal to 0.307 inches (gauge 0 wire). The number of horizontal support wires or shipping braces shall be limited to a maximum of five (5) per assembly. The center of the dowel assembly or insertion location shall be marked on both sides of the pavement slab for reference in sawing the joint. Dowel bars shall be furnished in a rigid welded assembly or, when the Contractor demonstrates that the placement can be made within required tolerances, placed by a dowel insertion machine. Assembly should be securely fastened to the Base/Subbase and constructed to firmly hold all the centerline of all dowel bars at T/2 depth with a minimum of three (3) inches cover, parallel to each other and to the pavement grade and alignment. See Detail indicated in the Contract Plans or standard Plan serials for the applicable section.

450.3.4.2.1 Individual Dowel Placement Tolerances

- Horizontal Skew (Rotational Alignment) = 1 ½" inches
- Vertical Tilt (Rotational Alignment) = 1 ½" inches
- Horizontal Translation = Two (2) inches
- Vertical Translation (Depth) = One (1) inch
- Longitudinal Translation = Three (3) inches



- Horizontal Skew – The deviation of the dowel bar from true parallel alignment from the edge of the pavement, measured over the entire length of the dowel bar.
- Vertical Tilt – The deviation of the dowel bar from true parallel alignment from the surface of the pavement, measured over the entire length of the dowel bar.
- Alignment – The degree to which a dowel bar aligns true (e.g., parallel) to the horizontal and vertical planes of the pavement.
- Misalignment – Any deviation in either the horizontal or vertical plane from a true alignment condition (e.g., horizontal skew or vertical tilt).
- Mislocation – Any deviation of the dowel bar from its planned location other than misalignment.

The Contractor is responsible for ensuring that the dowels remain properly aligned and in the proper locations before and during the placing procedure. The Contractor shall not cut the tie wires holding the baskets together before placing the concrete.

The Contractor shall thoroughly and uniformly coat each dowel and each tie wire along its full length with an approved form release agent not more than twelve (12) hours before concrete placement. The Contractor shall not use grease to lubricate the dowels. If the concrete placement is postponed or Delayed; the dowels will be re-coated.

Ground Penetrating Radar equipped with dual side-by-side antennas or approved equal by the Project Manager and State Concrete Engineer can be used for all embedded steel reinforcement. Magnetic Tomography (i.e. MIT Scan 2) may be utilized. Regardless of the equipment used, the results from the nondestructive testing shall be confirmed by drilling or coring for at least three (3) dowel bars within the first 120 linear feet of paving.

450.3.4.2.2 Joint Score

The Joint Score is the means of assessing locking potential. The Joint Score is evaluated for a single transverse joint between adjacent longitudinal joints and/or pavement edges.

**Table 450.3.4.2.2:1
WEIGHTING FACTORS USED TO DETERMINE JOINT SCORE**

Range of Rotational Misalignment	Weight
< 0.6 in.	0
≥ 0.6 in and < 0.8 in.	2
≥ 0.8 in and < 1 in.	4
≥ 1 in	5
Joint Rejection Criteria: 1. Any joint with a Joint Score greater than ten (10) is considered rejected. An individual joint may be allowed if the two (2) longitudinally adjacent joints each have a joint score less than or equal to ten (10). 2. Any joint that does not have at least three (3) acceptable dowel bars in each wheel path.	

450.3.4.2.3 Individual Dowel Bar Rejection Criteria

Rotational Alignment (Vertical Tilt and Horizontal Skew):

- Any bar with a misalignment greater than 1.5 inches.

Longitudinal Translation:

- Any bar with a mislocation greater than three (3) inches.
- Any bar that is not embedded at least six (6) inches on each side of the joint.

Vertical Translation (Depth):

- Any bar within the top three (3) inches of the pavement or at a depth less than the saw-cut depth.
- Any bar within the bottom three (3) inches of the pavement.
- Any bar with a mislocation of greater than one (1) inch.

Horizontal Translation:

- Any bar with a mislocation of greater than two (2) inches.

When rigid assemblies are used to install dowel bars and the bars are rejected for depth, the Contractor may core the pavement to verify the MIT 2 Scan depth results.

450.3.4.2.4 Dowel Bar Corrective Measures

The following corrective measures will be allowed for the bars or joints that are rejected:

- Rotational Misalignment:
 - Saw-cut the misaligned bars. Joints with less than three (3) un-cut bars in each wheel path will require the addition of dowel bars using an approved dowel bar retrofit method.

- Longitudinal and Horizontal Mislocation:
 - Addition of dowel bars using an approved dowel bar retrofit method.
- Depth:
 - Inadequate cover above the bar - Remove the bar and install a replacement bar using an approved dowel bar retrofit method.
 - Inadequate cover below the bar - Addition of dowel bars using an approved dowel bar retrofit method.
- Missing Dowel Bars:
 - Addition of dowel bars using an approved dowel bar retrofit method.

Retrofitting dowel bars shall not exceed the dowel bar rejection criteria.

In addition to the above procedures, the Contractor may propose removal and replacement of the affected slabs.

The Contractor shall submit the method of repair to the Project Manager for approval.

The Contractor shall demonstrate his ability to place dowel bars in conformance with the specifications by placement of a test section.

The test section shall be a minimum of 120 feet in length. Upon completion of the test section, the Contractor shall shut down paving operations. During the shutdown period, the Contractor shall evaluate all joints in the test section using the Ground Penetrating Radar, analyze the results and submit the results to the Project Manager. Paving operations shall not be restarted until the Project Manager approves the test section results. The test section will be found acceptable if 85% of the dowel bars placed are found to be within the acceptable tolerances stated in the rejection criteria. All dowel bars exceeding the Rejection Criteria must be addressed using the above corrective measures.

If the Project has less than 500 linear feet of pavement, the test section will not be required. If a Project does not have sections of continuous pavement greater than 45 linear feet, the test section will not be required.

Upon completion of the test section(s) and for each week of production, the Contractor shall prepare an electronic report generated using MagnoProof or equivalent software and submit it to the Project Manager at the start of each working week during production for the previous week's Work. All data shall be submitted in the manufacturer's native file format, along with the calibration files.

The electronic report shall include the following:

1. Control number, date, highway number and direction of traffic.
2. Joint number, lane number and station.
3. Bar number and x-location of dowel bar.
4. Horizontal and vertical misalignment of each bar in inches.
5. Overall misalignment of each bar in inches of each bar.
6. Side shift of each bar in inches.
7. Depth to center of each bar in inches.
8. Joint Score.

9. All measurements exceeding the rejection criteria shall be highlighted in red.

In addition to the electronic report provide all information required in the report as listed above on the final joint layout plan and provide to the Project Manager for Final Acceptance of the PCCP.

Due to potential magnetic interference from tie bars, dowel bars located within 15 inches of a tied joint shall not be included in the evaluation.

When the test section is found to be unacceptable, the Contractor shall perform corrective actions and place a second test section. If the second test section is found to be unacceptable, the Contractor shall pave no more than 500 feet per day until an acceptable test section has been achieved.

Once a test section is successfully completed, Dowel Bar Placement testing frequency shall be a minimum of one (1) location per 1,250 linear feet of each continuous lane including climbing lanes, passing lanes, acceleration and deceleration lanes and ramps or at the discretion of the Project Manager. Sections greater than 45 linear feet and less than 1,250 linear feet require a minimum of one (1) test location. Testing locations shall be determined by a random procedure so that each area has a randomly selected transverse joint location. At each location, five (5) consecutive joints shall be tested.

Sections of continuous pavement constructed less than 45 linear feet will not require Dowel Bar Placement Testing.

When any joint score is greater than ten (10) or any one (1) bar in a single joint exceeds the rejection criteria, joints shall be tested in each direction from the rejected joint, until two (2) consecutive joints in each direction are found to be within the rejection criteria.

All Delays or costs associated with dowel bar rejection will not be paid for by the Department.

The Contractor will be responsible for providing the appropriate equipment and qualified personnel to provide the specified tests and reports to the Project Manager. This work will be incidental to concrete pavement.

450.3.5 Finishing

After the concrete has been discharged from the truck, no additional water will be added to the concrete.

The Contractor shall provide a final surface finish that complies with the Project requirements for MRI, measured in accordance with Section 401, "Pavement Smoothness Measurement."

The Contractor shall correct pavement edge slumping (exclusive of specified edging) in excess of ¼ inch before the concrete hardens. If edge slump exceeds ¼ inch within ten (10) ft, or less, of hardened concrete, replace the entire panel between the transverse and longitudinal joints.

Before the concrete's initial set, the Contractor shall work the edges and joints with the appropriate tools to produce a well-defined and continuous radius with a smooth and dense mortar finish that is not segregated nor prematurely sealed. The Contractor shall minimize disturbance of the slab surface during finishing operations. It is the Contractor's responsibility not to over-work the surface of the fresh concrete. Any plastic shrinkage cracks that occur

shall be repaired or replaced at the discretion of the Project Manager at no cost in time or money to the Department.

The Contractor shall thoroughly clean the sawed area and, after completion of the sawing process. The Contractor shall seal the joint immediately, if required by the Project Manager.

The Contractor shall give the pavement a final wearing surface by tining or grooving as required in Section 450.3.5.1, "Texturing of PCCP."

450.3.5.1 Texturing of PCCP

Texturing of PCCP will be longitudinal tining.

When tining, the Contractor shall use a mechanical device such as a wire broom or comb having a single row of tines 1/8 inch +/- 1/64 inch width. The depth of groove in the plastic concrete shall be 1/8 inch +/- 1/16 inch. Tining will be Longitudinal unless otherwise specified in the Contract.

Longitudinal Tining: The tines shall be uniformly spaced at 3/4-inch intervals. The Contractor shall use Equipment with horizontal and vertical controls to ensure straight, uniform depth grooves. A two (2) inch to three (3) inch wide strip of pavement surface shall be protected from longitudinal surface grooving for the length of and centered over the longitudinal joints.

Transverse Tining: The tines shall be randomly spaced from 3/8 inch to 1 5/8 inch with no more than 50% of the spacing exceeding one (1) inch. The Contractor shall leave a four (4) inch to six (6) inch wide un-tined strip of pavement surface centered over each transverse joint.

The Contractor shall perform the tining operation at such time and manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets. Where abutting pavement is to be placed, the texturing shall extend as close to the edge as possible without damaging the edge. If abutting pavement is not to be placed, the six (6) inch area nearest the edge or one (1) foot from the face of the curb shall not be textured. All uniform width slabs of 20 feet or narrower and less than 600 feet in length, as well as mainline and ramp pavement during Equipment breakdowns, may be textured by hand methods.

When diamond grooving is specified or allowed in the Contract Plans, the Contractor shall allow concrete to cure, but no sooner than 48 hours groove the surface of the concrete in accordance with Section 455, "Diamond Grinding and Grooving of Portland Concrete Cement Pavement." Unless otherwise approved by the Project Manager, make grooves as required by the Project Specifications.

The Contractor shall stamp the concrete surface near the right hand edge of the panel at the start and end of paving each Day, indicating the date, month, and year of placement.

The Contractor shall stamp the concrete surface at 500-foot intervals near the right-hand edge of the pavement indicating the Roadway station.

450.3.5.2 Protection of Fresh Concrete

To protect the fresh concrete from unanticipated storm events, the Contractor shall keep enough waterproof sheeting at the placement location to cover the maximum anticipated

amount of pavement that can be placed in a three (3) hour period. The Contractor shall reserve this sheeting exclusively to protect the pavement.

450.3.5.3 Surfacing Smoothness Requirements

The Contractor shall test the longitudinal smoothness of the PCCP finished surface in each through traffic lane and passing lane with an approved Profile, in accordance with Section 401, "Pavement Smoothness Measurement."

The Department will exclude the following locations from the Profiler measurement (The Contractor shall evaluate them using a straightedge in accordance with Section 401, "Pavement Smoothness Measurement."):

1. Shoulders, ramps, tapers, holding lanes, turn-outs, Medians, concrete pavement slab removal and replacement Projects, intersections not paved integrally with the mainline, and other non-mainline pavement.

450.3.5.4 Straightedge Measurements

The Contractor shall measure the surface of PCCP not subject to Profiler measurements using an approved ten (10) foot straightedge at both right angles and parallel to the centerline. The Contractor shall correct surface deviations greater than ¼ inch within ten (10) feet.

450.3.6 Curing

For Curing, the Contractor Shall use Method 2 as described in Section 511.3.10.2, "Method 2, Curing Compound" except as amended here.

The Contractor shall apply curing compound in accordance with the Manufacturer's instructions. If the Manufacturer does not specify when application should begin, the Contractor shall apply the curing compound immediately after finishing and texturing but no later than 30 minutes. The Contractor shall maintain curing compounds in place as specified below until such time as the pavement is to be opened for traffic or until the concrete has reached 3,000 psi compressive strength, whichever occurs first. The Contractor shall not apply the curing compound in rainy conditions.

450.3.6.1 Application of Curing Compound

The Contractor shall thoroughly mix the membrane forming curing compound within an hour of use and agitate it during spraying operations. Before placing the curing compound in the spray tank, the Contractor shall thoroughly agitate it with compressed air, or other approved means, until the pigments in the original container are uniformly suspended. The Contractor shall not dilute or alter the curing compound in any way. The Contractor shall not use a curing compound that exhibits separation, segregation, or skinning.

The Contractor shall apply curing compound to the entire area of the exposed concrete surface with an approved mechanical spray machine. The Contractor shall protect the fog spray from the wind with an adequate shield and apply uniformly until it completely covers the entire surface without gaps or openings in the coverage. The Contractor shall spray the concrete surface uniformly with two (2) coats of approved curing compound at an individual application rate of not more than 180 sq. ft. per gallon. The Contractor shall apply the first coat within ten (10) minutes after completing texturing operations. The Contractor shall apply the second coat within 30 minutes after completing texturing operations. The Contractor shall immediately reapply the curing compound over any control joints that were cut through previously applied coatings of curing compound.

The Contractor shall protect all surfaces covered with curing compound for three (3) Days after application. The Contractor shall re-apply curing compound in areas damaged by subsequent work activities.

The Contractor shall place the curing compound directly into the spray tanks from the manufacturer's original containers bearing the manufacturer's name, brand, and lot number.

If, because of cold temperature, the curing compound becomes too viscous for proper stiffening or application, or if portions of the curing compound have been precipitated from solution, the Contractor shall follow the manufacturer's recommendations to restore proper fluidity and dispersion.

If rain falls on freshly applied curing compound before it has dried enough to resist damage, or if the surface is otherwise damaged, the Contractor shall apply an additional coat of curing compound.

450.3.7—Reserved

450.3.8 Protections from and Opening to Traffic

The Contractor shall protect new pavement against public traffic and operational and employee traffic. The Contractor shall provide personnel to direct traffic. The Contractor shall erect and maintain warning signs, lights, pavement Bridges, or crossovers in accordance with the Contract's traffic control requirements.

The Contractor shall not open to traffic for a least three (3) Calendar Days or until the concrete has reached a compressive strength of 3,000 psi as determined by the Maturity Method, in accordance with Section 510.3.4.2.2, "In-Place Concrete Strength Measurements," unless the Project Manager directs otherwise.

The Contractor shall clean the pavement of loose Materials and debris before opening to traffic.

450.3.9 Test Strip

The Contractor shall construct a test strip a minimum of 0.1 mile, but not more than 0.2 mile in length for each CPPC mix design with a minimum of three (3) Contractor and three (3) agency samples to evaluate the process control, and placement operations. The Contractor shall construct test strip on shoulder, low volume segments of the pavement, or area approved by the Project Manager. The Contractor shall correct and modify non-complying placement operations and produce necessary process control adjustments. The Contractor shall develop a revised placement method if necessary based on the results of the test strip. Production and placement operations prior to approval of the revised placement operations are at the Contractor's risk.

The test strip will be evaluated in conformance in accordance with this Section. If accepted, the test strip will have a pay factor of one (1.0). If rejected, said Material shall be handled in accordance with Table 450.3.10.2.1:1, "Acceptance Limits." The Contractor shall remove unaccepted test strip Material placed within the Roadway Prism at no cost to the Department. If the Contractor disagrees with removing and replacing unacceptable Material placed in test strips outside the Roadway Prism, the Assistant District Engineer for Construction, based on his or her engineering judgment, will decide if the Material can remain in place with a maximum pay factor of 50%, or shall be removed and replaced at no cost to the

Department. If the test strip is rejected, the Contractor shall construct a subsequent test strip. The Contractor shall not proceed to full production until an Accepted test strip is produced.

450.3.10 Sampling and Testing

The Contractor shall sample and test the aggregate production and PCC mixture in accordance with Section 902, "Quality Control;" Section 903, "Quality Assurance;" and Section 906, "Minimum Testing Requirements." Department personnel may test locations other than the random locations generated for statistical analysis. These tests will not be used for pay factor determination, but may be used to determine Acceptance or rejection of localized Material.

450.3.10.1 Contractor Quality Control

The Contractor shall administer a Quality Control Plan, referred to hereafter as "the Plan" to provide a product in accordance with the Contract. The Contractor shall ensure the Plan conforms to Section 902, "Quality Control." The Contractor shall submit the Plan a minimum of two (2) weeks prior to PCCP pre-placement meeting. No PCCP operations are allowed until the Plan has been approved by the Project Manager and District Lab Supervisor.

The Contractor shall ensure the plan addresses all elements that affect the quality of the Portland cement concrete paving, including but not limited to:

1. Mix designs;
2. Aggregate production;
3. Quality of components;
4. Stockpile management;
5. Batching;
6. Mixing;
7. Transporting;
8. Placing;
9. Vibration and consolidation;
10. Finishing;
11. Joints;
12. Smoothness;
13. Hot/Cold Weather Placement and Curing Plan(s);
14. Curing method;
15. Thickness;
16. Placement phasing;
17. Rumble strips if required; and
18. Non Destructive Testing Methods (including Project calibration process).

The Contractor shall make sure the Plan identifies personnel responsible for sampling and testing of PCCP, and how to contact them at any time. The Contractor shall make sure that qualified sampling and testing personnel perform PCCP sampling and testing in accordance with Section 906, "Minimum Testing Requirements." The Contractor shall provide at least two (2) qualified technicians, as follows:

1. The Process Control Technician (PCT) is responsible for performing inspection, sampling, and testing at the concrete batching facility and at the Contractor's field

Laboratory. The PCT shall use Laboratory test results and other Quality Control practices to assure the quality of aggregate sources and other mix components, and adjust and control mix proportioning to meet the mix designs. The PCT shall periodically inspect Equipment used in proportioning and mixing to assure its proper operating condition and to assure that the Contractor performs proportioning and mixing in accordance with the mix design and other requirements.

2. The Quality Control Technician (QCT) is responsible for inspection, sampling, and testing at the paving site. The QCT shall assure that the delivered Materials comply with the requirements of the Contract. The QCT shall periodically inspect Equipment used to transport, place, and finish the concrete to assure its proper operating condition, and to assure that the Contractor provides a final constructed product in accordance with the Contract.

The Plan must coordinate and document the activities of the PCT and QCT. This includes the frequencies for each test, the criteria to reject or correct unsatisfactory Materials, and a description of what corrective actions can be taken, and how and when the actions will be initiated.

The Plan will detail the sampling and testing programs, including methods to determine and apply random sampling locations. The Contractor shall perform sampling and testing in accordance with Section 906, "Minimum Testing Requirements."

450.3.10.2 Department Quality Assurance

The Department will sample and test the Material on a statistically random basis in accordance with Section 903, "Quality Assurance" and Section 906, "Minimum Testing Requirements."

450.3.10.2.1 Acceptance

The Department will evaluate and Accept Materials using Contractor and Department test data in accordance with Section 904, "Quality Level Analysis" and Section 906, "Minimum Testing Requirements."

In addition to as indicated above, the thickness of the plastic concrete shall be determined by the Contractor by taking stab depth measurements during paving at intervals not greater than 100 feet intervals. The recorded depth shall be the average of three (3) depths taken per location and the three (3) locations shall be within 18 inches of one another. The Contactor shall stab and measure at the lane lines. When the edge of the concrete being placed falls at a lane line; the measurement shall be offset two (2) ft from that line. The Contractor shall keep a log (date, before or behind paver, depth station and offset) of these measurements and provide the NMDOT a copy ever week, unless otherwise requested.

**Table 450.3.10.2.1:1
Acceptance Limits**

Characteristic	Specification limits, from TV
Entrained air (from the appropriate Freeze/Thaw Risk Zone)	± 1.5%
*Target Compressive Strength (From approved mix design)	± 1,000 psi
Thickness (From Project Specifications)	+ 1 inch/-1/4 inch
Unless otherwise provided in the Contract, target values for Acceptance shall be as follows:	

**Table 450.3.10.2.1:1
Acceptance Limits**

Entrained air	Target Air Content for the Freeze/Thaw Risk Zone in which the Project is located
Compressive strength	Target strength from mix design
Thickness	Nominal plan thickness +1 inch/-1/4 inch
*Target Compressive Strength will be the average compressive strength of the first thirty (30) tests from the Contractor's QLA testing program. If the Contractor's data does not validate with the departments data, the Target Compressive Strength will be the average of the first ten (10) Department tests.	

450.3.10.3 Independent Assurance Testing

The Department will perform Independent Assurance sampling and testing in accordance with Section 906, "Minimum Testing Requirements."

450.4 METHOD OF MEASUREMENT

The Department will only pay for the average thickness of pavement in accordance with the Plans.

The Department considers dowels, tie bars, joint Materials, and required coring, including the filling of core holes with concrete, Incidental to the Work in accordance with section 450, "Portland Cement Concrete Pavement ."

The quantities for PCCP will be measured in square yards (Sq Yd) completed and Accepted. The width for measurement will be the width of the pavement shown on the typical cross section of the Plans, including additional widening where called for, or as otherwise directed by the Project Manager in writing. The length will be measured horizontally along the centerline of each roadway and ramp.

450.5 BASIS OF PAYMENT

The Department will adjust the PCCP unit bid price in accordance with Section 904, "Quality Level Analysis." The Department will pay for PCCP on a lot-by-lot basis at a price determined by multiplying the unit bid price by the composite pay factor. The Department will use Table 450.5:1, "Composite Pay Factor," to calculate the composite pay factor. Composite Pay factors greater than one (1.0) will be paid for as one (1.0).

**Table 450.5:1
Composite Pay Factors**

Measured characteristic	Factor "f"
Entrained air	25
Compressive strength	25
Thickness	25
Dowel bar tolerances	25

Pay Item

Concrete Pavement

Pay Unit

Square Yard

450.5.1 Work Included in Payment

The Department will consider as included in the payment for pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Dowels, tie bars, and joint Materials.
2. Mixing, hauling, placement, jointing, texturing, finishing, and curing of concrete pavement.
3. Quality Control in accordance with Section 902, "Quality Control."
4. Required coring and filling core holes with concrete.
5. Providing Mix Design in accordance with Section 509, "Portland Cement Concrete Mix Designs."

SECTION 451: PORTLAND CEMENT CONCRETE PAVEMENT (PCCP) (Non-QLA)

451.1 DESCRIPTION

See Section 450.1, "Description."

451.2 MATERIALS

See Section 450.2, "Materials."

451.3 CONSTRUCTION REQUIREMENTS

451.3.1 Proportioning

See Section 450.3.1, "Proportioning."

451.3.2 Equipment

See Section 450.3.2, "Equipment."

451.3.3 Operations

See Section 450.3.3, "Operations."

451.3.4 Joints

See Section 450.3.4, "Joints."

451.3.5 Finishing

See Section 450.3.5, "Finishing."

451.3.6 Curing

See Section 450.3.6, "Curing."

451.3.7 Grooving of PCCP

See Section 450.3.5.1, "Texturing of PCCP."

451.3.8 Protection from, and Opening to, Traffic

See Section 450.3.8, "Protection from, and Opening to, Traffic."

451.3.9 Sampling and Testing

451.3.9.1 Contractor Quality Control

451.3.9.2 Department Quality Assurance

451.3.9.2.1 Acceptance

The Department will Accept the finished pavement, with respect to strength, in accordance with Section 510.3.4.3, "Concrete Sampling and Testing." The Department will Accept the finished pavement, with respect to thickness, based on test areas less than

2,400 yd² in size, randomly selected by the Project Manager. The Department will make thickness determinations either using cores located in a random pattern with at least two (2) cores in each test area or by drilling holes greater than ½ inch diameter completely through the PCCP and determining the thickness from the drilled hole. Core holes shall be filled with self-leveling sealant Material as specified in Section 452, "Sealing and Resealing Concrete Pavement Joints" including round closed-cell bondbreaker as described in Section 452.2.3, "Bondbreaker." These repairs shall be considered incidental. The Contractor shall complete all corrective Work in accordance with Section 450.3.5.2, "Surfacing Smoothness Requirements," before the Department determines pavement thickness.

The Department will Accept test areas when an average of the measurements is not less than 1/4 inch from the required thickness, and when any measurement is not less than 3/4 inch from the required thickness.

451.3.9.3 Independent Assurance Testing

The Department will perform Independent Assurance sampling and testing in accordance with Section 906, "Minimum Testing Requirements."

451.4 METHOD OF MEASUREMENT

The Department will measure concrete pavement using the dimensions shown in the Contract or approved modifications.

451.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Concrete Pavement __ inch	Square Yard

The Department will only pay for the average thickness of pavement in accordance with the Plans.

The Department considers dowels, tie bars, joint Materials, and required coring, including filling the core holes with concrete, incidental to the Work in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints."

451.5.1 Price Adjustments

451.5.1.1 Thickness

The Department will apply price adjustment for concrete pavement with deficient thickness based on a structural engineering analysis conducted by the Department that will determine the percent loss of traffic carrying ability based on the original design ESAL.

451.5.1.2 Strength

See Section 510.3.5.5, "Price Adjustments."

451.5.1.3 Final Adjustment in Bid Item Unit Price per Lot

When test results allow price adjustments, the resultant adjustment will be cumulative.

451.5.2 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Dowels, tie bars, and joint Materials;
2. Mixing, hauling, placement, jointing, texturing, finishing, and curing of concrete pavement;
3. Required coring and filling core holes with concrete; and
4. Providing Mix Design in accordance with Section 509, "Portland Cement Concrete Mix Designs."

SECTION 452: SEALING AND RESEALING CONCRETE PAVEMENT JOINTS

452.1 DESCRIPTION

This Work consists of cleaning, priming, and sealing concrete pavement joints. This Work also consists of removing joint sealant, sawing, cleaning, priming, and resealing joints.

The Contractor shall seal only joints between adjacent portland cement concrete surfaces. The Contractor shall seal joints between PCCP and asphalt pavement in accordance with Section 411, "Hot-Poured Crack Sealant," unless otherwise shown on the Plans.

452.2 MATERIALS

452.2.1 Sealant

Joint sealant Material will either be a Type NS or SL single component silicone formulation meeting the requirements of ASTM D 5893 or a single component low modulus polyurethane formulation meeting the requirements of ASTM C 920 and Table 452.2.2:1, "Polyurethane Sealant Physical Requirements."

The Contractor shall provide a qualified manufacturer's representative on the Project for at least the first Day of sealant application. The Contractor shall prepare and seal the joints in accordance with proper procedures approved by the manufacturer's representative.

The Contractor shall obtain the manufacturer's written verification of primer, backer, and sealant compatibility.

452.2.2 Certification

For each lot of sealant applied to concrete pavement joints, the Contractor shall provide certified test results in accordance with ASTM D 5893 or ASTM C 920 and Table 452.2.2:1, "Polyurethane Sealant Physical Requirements," except as otherwise provided in the Contract.

The Contractor shall provide sealant test results and verification that the product is currently within the manufacturer's recommended shelf life to the Project Manager at least ten (10) Days before sealant installation. Certification will show areas of primer use.

**Table 452.2.2:1
Polyurethane Sealant Physical Requirements**

Property	Test Method	Requirement
Tensile Stress, 150% Elongation, 21 Day cure @ 77oF and 45 – 55% R.H., psi	ASTM D 412 Die C	150 - 200
Tack-Free Time, h, maximum	ASTM C 679	2 - 6
Adhesion & Cohesion under cyclic movement	ASTM C 719	Pass
Artificial Weathering	ASTM C 793	Pass
Weight (mass) Loss, %, maximum	ASTM C 792	10
Ozone and U.V. Resistance	ASTM C 793	Note 1
Movement Capability and Adhesion	Note 2	
Note 1: The sealant shall show no chalking, cracking, or bond loss after 250 hours.		
Note 2: The sealant shall show no adhesive or cohesive failure after ten (10) cycles of ± 50%		

Table 452.2.2:1
Polyurethane Sealant Physical Requirements

of joint width with the rate of extension or compression being no greater than 1/8 inch per hour.

452.2.3 Bondbreaker

The bondbreaker is a round closed cell, nonabsorbent Material compatible with the sealant Material, that is at least 1/8 inch larger in diameter than the width of the joint being sealed. If primer is required, the Contractor shall ensure that no adverse reaction occurs between the bondbreaker and sealant or primer.

452.3 CONSTRUCTION REQUIREMENTS

452.3.1 General

The Contractor shall repair damage to the pavement surface, at no additional cost to the Department. The Contractor shall perform these repairs to the concrete surfaces before beginning sealing operations, as directed by the Project Manager.

The Contractor shall dispose of old sealant Materials in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to Public."

452.3.2 Temperature and Weather Limitations

The Contractor shall perform joint sealing or resealing only under the following conditions:

1. The air and pavement temperatures are 40 °F or higher;
2. The pavement temperature is above the dew point;
3. The pavement and joint faces are dry and frost free; and
4. Weather conditions are dry.

452.3.3 Resealing Operations

The Contractor shall saw the transverse and longitudinal joints to the specified width, depth, and configuration.

452.3.4 Joint Preparation

The Contractor shall use a router to follow the path of random cracks and widen the top of the crack to the required section.

The Contractor shall sandblast joints and clean with compressed air.

The Contractor shall provide a one (1) inch wide border of clean, dry, newly exposed concrete before applying the bondbreaker and sealant at the joint and adjacent pavement.

The Contractor shall use cleaning wands that provide compressed air with at least 100 psi of pressure at the outlet nozzle. The Contractor shall ensure that the compressed air is free of oil and moisture.

452.3.5 Sealant Application

The Contractor shall apply the sealant according to the manufacturer's recommendations, unless otherwise specified and approved by the Project Manager. The Contractor shall obtain Project Manager approval of the manufacturer's sealant application instructions before beginning Work.

The Contractor shall place the bondbreaker to maintain the specified depth of the sealant Material.

The Contractor shall provide a finished joint seal surface that is concave and 1/4 inch ± 1/8 inch below the surface of the concrete pavement.

The Project Manager will cease operations if the Contractor seals joints inconsistently. The Contractor shall correct inconsistencies in joint sealing operations and remove and replace non-conforming sealant at no additional cost to the Department.

452.4 METHOD OF MEASUREMENT

Sealing concrete pavement joints and resealing concrete pavement joints will be measured by the linear foot.

452.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Sealing Concrete Pavement Joints</i>	Linear Foot
<i>Resealing Concrete Pavement Joints</i>	Linear Foot

452.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Cleaning, priming, and sealing concrete pavement joints;
2. Removing joint sealant, sawing, cleaning, priming, and resealing joints; and
3. Provide sealant Material.

SECTION 454: CRACKING AND SEATING CONCRETE PAVEMENT

454.1 DESCRIPTION

This Work consists of cracking and seating existing portland cement concrete pavement.

454.2 MATERIALS—Reserved

454.3 CONSTRUCTION REQUIREMENTS

454.3.1 Equipment

The Contractor shall use impact hammers capable of cracking the pavement's full depth. The Contractor shall equip the breaker with a plate-type shoe or use one designed to prevent penetration, spalling, and shattering of the existing surface, the Contractor shall use other Equipment approved by the Project Manager. The Contractor shall not use a headache, drop ball, or whip hammer.

If required, the Contractor shall provide a screen to protect vehicles in the adjacent lane from flying chips during the cracking process.

The Contractor shall use pneumatic tire rollers that weigh a minimum of 50 ton.

454.3.2 Cracking Operations

Before cracking the concrete, the Contractor shall remove existing asphalt patches. Before cracking, the Project Manager will designate test sections. The Contractor shall crack the test sections using varying energy and striking patterns to establish an optimum pattern for cracking the pavement. The Contractor shall wet the pavement surface test section to determine the extent and pattern of cracking.

The Contractor shall use the established pattern to crack the pavement on the remainder of the Project, provided the cracked pavement continues to meet the specified size requirements. The Contractor shall adjust the energy and striking pattern as directed by the Project Manager. The Contractor shall wet pavement surfaces at least once an hour to determine the extent and pattern of cracking.

The Contractor shall crack the existing concrete pavement so that the dimensions of the majority of pieces of pavement are from 18 inches to 24 inches, with a maximum dimension of 30 inches. The Contractor shall ensure that 80% of pavement pieces are smaller than 24 inch. The Project Manager will determine the adequacy of pavement breakage.

The Contractor shall perform cracking one (1) lane at a time with an impact hammer.

The Contractor shall prevent damage to underground utilities, drainage facilities, Bridge approach slabs, and Bridge decks. The Contractor shall repair damage at no additional cost to the Department.

454.3.3 Seating Operations

After cracking the concrete pavement, the Contractor shall clean the surface of loose and spalled concrete and foreign Material.

The Contractor shall roll the cracked concrete with a pneumatic tire roller within 24 h before overlaying with HMA until it is well seated and thoroughly and uniformly compacted.

The Contractor shall crack slab sections (that do not seat well under the roller) into smaller sections and roll them again. The Project Manager will determine when the pavement is properly cracked and seated.

The Department will allow traffic on the cracked pavement before overlaying. When routing traffic over the cracked pavement, the Contractor shall ensure the pavement's condition is satisfactory to carry the traffic.

454.4 METHOD OF MEASUREMENT

Cracking and seating concrete pavement will be measured by the square yard.

454.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Cracking and Seating Concrete Pavement</i>	Square Yard

454.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Cracking concrete pavement full depth;
2. Remove existing asphalt patches;
3. Clean cracked concrete surface of loose debris; and
4. Roll cracked concrete pavement.

SECTION 455: DIAMOND-GRINDING AND DIAMOND-GROOVING OF PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

455.1 DESCRIPTION

This Work consists of diamond-grinding and/or diamond-grooving PCCP, and includes the removal of slurry and residue resulting from the Work.

Diamond grinding is a pavement preservation technique that corrects a variety of surface imperfections on both concrete and asphalt pavements. The diamond blades used for grinding are composed of industrial diamonds and metallurgical powder.

455.2 MATERIALS—Reserved

455.3 CONSTRUCTION REQUIREMENTS

455.3.1 Equipment

The Contractor shall use power-driven, self-propelled machines equipped with diamond blades specifically designed to grind, groove, and texture PCCP. The Contractor shall ensure the grinder has a depth control device to detect variations in the concrete surface and adjust the cutting head height to maintain the depth of the specified groove. The Contractor shall equip the diamond grinding machine with alignment control devices.

The Contractor shall ensure the Equipment grinds and grooves the pavement surface to the specified smoothness tolerances and textures, without causing excessive raveling of the joints or cracking or fracturing of the aggregates.

455.3.2 Diamond Grinding and Grooving Operations

The Contractor shall begin and end longitudinal diamond grinding and grooving at lines normal to the pavement centerline, unless otherwise specified in the Contract.

The Contractor shall grind designated areas until the pavement surfaces on both sides of transverse joints and cracks are on the same plane. The Contractor shall ensure that diamond grinding produces a uniform finished surface, eliminates joint or crack faults, and provides positive lateral surface drainage by maintaining a constant cross-slope within the diamond grinding limits of each lane.

The Contractor shall grind auxiliary or ramp lane transitions from the mainline edge to provide positive drainage and an Acceptable riding surface.

The Contractor shall make grooving patterns in accordance with Section 512.3.10.3, "Grooving of Hardened Concrete," unless otherwise specified in the Contract.

455.3.3 Slurry Removal

The Contractor shall continuously remove the slurry from the Work.

The Contractor shall not allow the slurry to flow across lanes open to traffic or into gutters or other drainage facilities.

455.3.4 Final Surface Finish

The Contractor shall produce a pavement surface in accordance with Section 450.3.5.3,

“Surfacing Smoothness Requirements.”

The Contractor shall ensure the texture has parallel longitudinal corrugations that present a narrow ridge corduroy-type appearance. The Contractor shall make the peaks and grooves approximately 0.08 inch apart in elevation. The Contractor shall make the grooves from 0.08 inch to 0.16 inch wide, and the peaks from 0.08 inch to 0.12 inch wide. The Contractor shall determine the appropriate number of grooves per yard to produce the specified surface requirements.

455.3.5 Acceptance

The Contractor shall inspect transverse joints and random cracks to ensure that adjacent surfaces are in the same plane. The Contractor shall regrind as directed by the Project Manager, at no additional cost to the Department.

455.4 METHOD OF MEASUREMENT

The Department will measure the Diamond Grinding and Diamond Grooving of Portland Cement Concrete Pavement actually ground or grooved on the top width and length of the pavement if paid by the unit. If no Bid Item exists for Diamond Grinding and Diamond Grooving of Portland Cement Concrete Pavement, payment will be Incidental to Section 450, “Portland Cement Concrete Pavement (QLA)” or Section 451, “Portland Cement Concrete Pavement,” as applicable.

455.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Diamond Grinding of PCCP</i>	Square Yard
<i>Diamond Grooving of PCCP</i>	Square Yard

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SECTION 501: DRIVEN PILES

501.1 DESCRIPTION

The Work consists of providing and driving piles, including splicing additional pile lengths and cut-offs.

501.2 MATERIALS

501.2.1 Standards

The Contractor shall provide Materials in accordance with Table 501.2.1:1, "Applicable Pile Standards."

**Table 501.2.1:1
Applicable Pile Standards**

Material description	Standard
Structural Steel piles and columns (HP)	ASTM A 572, Grade 50
Splice plates for Structural Steel piles	AASHTO M 270, Grade 50
Castings for pile shoes	ASTM A 148
Steel pipe (longitudinal or continuous spiral welded) piles and columns	ASTM A 252, Gr. 3
Backing rings for steel pipe pile splices	ASTM A 252, Gr. 3
End plate for closed end pipe piles	AASHTO M 270, Grade 50
Portland cement concrete, Class G	Section 509, "Portland Cement Concrete Mix Designs."
Precast pre-stressed concrete piles	Section 518, "Pre-Stressed Concrete Members."
Paint	Section 544, "Protective Coating of New Structural Steel."

501.2.2 Piles

501.2.2.1 Steel Piles

The Contractor shall use no more than one (1) field splice to make steel piles that are from 30 ft to 80 ft long. The Contractor shall use no more than two (2) field splices to make steel piles longer than 80 ft. The minimum Acceptable splice length is five (5) ft. The Contractor shall not use more than two (2) splices per steel pile. The Department will not Accept camber and sweep more than the mill tolerance.

501.2.2.2 Continuous Spiral Weld Pipe Piles

The Contractor shall provide longitudinal or spiral welded pipe, on the Department's Approved Products List, with only complete full joint penetration welds conforming to the requirements of AWS D1.1 – Structural Welding Code.

501.2.2.3 Pre-cast Pre-stressed Concrete Piles

The Contractor shall manufacture pre-cast pre-stressed concrete piles in accordance with Section 518, "Pre-Stressed Concrete Members."

501.2.2.4 Pile Splices

The Contractor shall provide Materials in accordance with Table 501.2.1:1, "Applicable Pile Standards." The Contractor shall use prefabricated splices only when specified. If the Contract requires additional length due to inadequate bearing, the Contractor shall construct splices in accordance with Section 501.3.6.5, "Splices."

The Contractor shall perform field welding inspection in accordance with Section 541.3.6.4, "Field Welding."

501.2.3 Submittals

The Contractor shall submit the following to the Project Manager:

1. Three (3) certified copies of mill test reports (MTR) for the following:
 - 1.1. Structural Steel piles;
 - 1.2. Pile columns;
 - 1.3. Steel pipe piles and pipe pile columns;
 - 1.4. Splice plates;
 - 1.5. Backing rings;
 - 1.6. End plates; and
 - 1.7. Pile shoes;Indicate heat numbers on test reports and on each pile provided.
2. Welder Certification in accordance with Section 541, "Steel Structures," sufficient for welding field splices and end plates;
3. Class G concrete mix design approved by the State Concrete Engineer in accordance with Section 509, "Portland Cement Concrete Mix Designs;"
4. Pre-cast pre-stressed concrete piles certification and testing in accordance with Section 518, "Pre-Stressed Concrete Members;" and
5. Paint certification in accordance with Section 544, "Protective Coating of New Structural Steel."

501.2.3.1 Pile Driving Equipment Submittals

The Contractor shall submit pile driving Equipment information to the Project Manager 30 Days before beginning pile driving. The Contractor shall submit the information on the Department's *Pile and Driving Equipment Data Form*. The Contractor shall provide information required on the form including the following:

1. Pile hammer make, model number, and serial number;
2. Driving head assembly, type, model number, and weight;
3. Hammer cushion, Material, size, and thickness; and
4. Pile cushion, Material, size, and thickness.

The Department has fourteen (14) Days to Accept or reject the proposed pile driving Equipment after the Project Manager receives the *Pile and Driving Equipment Data Form*. Acceptance will be in accordance with Section 501.3.1.4, "Approval of Driving System."

If the Department rejects the Equipment, the Contractor shall modify or replace the pile driving Equipment and revise and resubmit the form. The Department will have seven (7)

Days to Accept or reject the revised *Pile and Equipment Data Form*.

The Contractor shall submit the manufacturer's chart showing stroke and blows per minute when proposing the use of open-end (single-acting) diesel hammers.

The Contractor shall submit a chart equating bounce chamber pressure and hose length to either equivalent energy or stroke when proposing use of closed-end (double-acting) diesel hammers. The Contractor shall specify hose lengths for closed-end hammers. The Contractor shall calibrate the chart to atmospheric pressure based on the Project site elevation to the nearest 1,500 ft elevation.

The Contractor shall submit a chart equating the plant operating pressure to the equivalent delivered energy of the hammer, including losses in the hose, when proposing the use of double acting or differential acting air/steam hammers. The Contractor shall calibrate the chart to atmospheric pressure based on the Project site elevation to the nearest 1,500 ft elevation.

The Contractor shall submit a certificate of calibration to the Project Manager for the pressure gauge required for double acting hammers or for delivered energy for hydraulic hammers. The Contractor shall provide certificate of calibration from a National Institute of Standards and Technology traceable Laboratory performed no more than six (6) months before use.

501.3 CONSTRUCTION REQUIREMENTS

501.3.1 Pre-Pile Driving Conference

The Project Manager will hold a Pre-Pile Driving Conference at least seven (7) Days before the anticipated pile driving begins to review the Specification requirements and discuss the Contractor's preparations. The Contractor shall ensure that at a minimum the following attend the conference:

1. Pile Driving Superintendent;
2. Pile Driving Inspector;
3. Foundation Engineer of Record (available for consult via teleconference); and
4. Prime Contractor.

The recommended agenda is available from the State Geotechnical Engineer.

501.3.2 Equipment

501.3.2.1 Pile Hammers

The Contractor shall use diesel or hydraulic hammers for driving piles. The Contractor shall only use gravity hammers where specified for use in dynamic testing of drilled shafts.

501.3.2.1.1 Diesel Hammers

The Contractor shall use open-end diesel hammers that allow the Inspector to see the hammer stroke during pile driving operations, unless accompanied by a saximeter stroke measurement device.

The Contractor shall use closed-end diesel hammers equipped with a bounce chamber pressure gauge, mounted with a hose long enough for the Inspector to read.

501.3.2.1.2 Hydraulic Hammers

The Contractor shall use hydraulic hammers equipped with a digital display of delivered hammer energy for each stroke. The Contractor shall provide certification of hammer energy measurement read-out to the Project Manager.

501.3.2.2 Driving Apparatus

501.3.2.2.1 Hammer Cushion

The Contractor shall equip impact pile driving Equipment (except gravity and hydraulic hammers) with hammer cushion Material to prevent damage to the hammer or pile and to ensure uniform driving. The Contractor shall use hammer cushions made in accordance with the hammer manufacturer's guidelines. The Contractor shall not use wood, wire rope, or asbestos hammer cushions. The Contractor shall place a manufacturer-recommended striker plate on the hammer cushion to ensure uniform compression of the cushion Material.

501.3.2.2.2 Drive Head

The Contractor shall equip impact hammer driven piles with a steel drive head to distribute the hammer blow. The Contractor shall align the drive head axially with the hammer and the pile. The Contractor shall ensure that it is guided by leads and not free-swinging.

The Contractor shall use a drive head that fits around the pile head to maintain the proper alignment of the hammer and pile and not transfer the torsional forces during driving. The Contractor shall cut pile heads squarely. The Contractor shall provide a drive head insert to fit the pile type and dimensions, as recommended by the hammer manufacturer.

For pre-cast concrete and pre-stressed concrete piles, the Contractor shall use a pile head that is perpendicular to the longitudinal axis of the pile to prevent eccentric impacts.

501.3.2.2.3 Pile Cushion

Before driving, the Contractor shall place a plywood pile cushion that is at least four (4) inches thick on the pile head. Greater thicknesses may be required if the Wave Equation Analysis (per Section 501.3.3.1.1, "Wave Equation Analysis") or dynamic testing (per Section 501.3.3.1.2, "Dynamic Formula") determines that the pile compressive or tensile stresses are unacceptable.

501.3.2.2.4 Leads

While being driven, the Contractor shall support piles in line and position with leads. The Contractor shall construct pile driver leads to allow the hammer free movement while maintaining alignment of the hammer and the pile to ensure concentric impacts.

The Contractor shall not extend the pile section being driven above the leads. The Contractor shall embed the leads in the ground or restrain by a rigid brace to maintain alignment. The Contractor shall ensure that the leads are long enough to make a follower unnecessary, and design the leads to permit alignment of batter piles.

The Contractor shall use fixed or swinging leads. The Contractor shall fit swinging leads with a pile gate at the bottom. For batter piles, the Contractor shall use a horizontal brace between the crane and the leads.

501.3.2.2.5 Pile Extensions

The Contractor shall not use followers. Where required and approved by the State Geotechnical Engineer, the Contractor shall use an extra length pile with splices (if necessary) and ensure that the leads are of adequate length so that followers will not be required. After cut-off, undamaged extra length pile may be re-used as a production pile.

501.3.2.2.6 Templates

The Contractor shall use securely anchored heavy metal templates to maintain pile positions when driving a pile bent.

501.3.2.2.7 Pre-Boring Equipment

The Contractor shall use pre-boring Equipment in accordance with Section 501.3.4.2, "Pre-Boring."

501.3.2.2.8 Inspection Equipment

The Contractor shall provide and use Equipment to illuminate the entire interior length of pipe piles after they are driven.

501.3.2.3 Minimum Manufacturer's-Rated Hammer Energy

Unless the Contract specifies a minimum hammer energy, the Contractor shall use a manufacturer-rated hammer at or above the appropriate minimum energy level corresponding to the required nominal pile capacity in accordance with Table 501.3.2.3:1, "Required Hammer Energy."

**Table 501.3.2.3:1
Required Hammer Energy**

Nominal Pile Capacity (Kips)	Minimum Manufacturer's Rated Hammer Energy (Ft - lb)
≤ 225	45,000
226 – 350	50,000
351 – 400	55,000
401 – 450	60,000
≥ 451	Wave Equation Analysis required

501.3.2.4 Approval of Driving System

The State Geotechnical Engineer will approve the driving system. The driving system includes the hammer and driving apparatus proposed on the Department's *Pile and Driving Equipment Data Form*. Transporting the driving system to the Project site before it is approved will be done at the Contractor's risk.

The driving system will be approved based on the following:

1. The driving system meets the requirements of Sections 501.3.2.1, "Pile Hammers," and 501.3.2.2, "Driving Apparatus;"
2. The manufacturer's rated hammer energy meets or exceeds the minimum hammer energy requirements established in Section 501.3.2.3, "Minimum Manufacturer's-Rated Hammer Energy;"

3. The Wave Equation Analysis indicates that the expected driving resistance (required nominal capacity) can be achieved at less than ten (10) blows per inch;
4. The Wave Equation Analysis indicates that the pile stresses will not exceed the allowable stresses at the expected driving resistance (required ultimate capacity) as indicated in Table 501.3.2.4:1, "Wave Equation Analysis Allowable Driving Stress;" and
5. When dynamic tests are specified in accordance with Section 504, "Load Testing of Bearing Piles," Acceptance of the hammer system will be based on the measured energy transfer efficiency in accordance with Section 501.3.5, "Variations of Approved Driving Systems."

**Table 501.3.2.4:1
Wave Equation Analysis Allowable Driving Stress**

Description	Maximum stress ^{a,b}
Steel piles	
Compressive stress	90% of yield strength (0.90 F _y)
Concrete piles	
	85% of the compressive strength ^c minus the effective pre-stress
Compressive stress	(0.85 F' _c - effective pre-stress)
Tensile stress	(3√F' _c + effective pre-stress)

^aIf the pile stresses determined by Wave Equation Analysis exceed the allowable stresses, the Department may approve the hammer system if a heavier pile section approved by the State Geotechnical Engineer is substituted. If necessary, the Contractor shall provide heavier piles at no additional cost to the Department.

^bIf the pile stresses determined by Wave Equation Analysis exceed the allowable stresses, the Department may approve the hammer system if additional static or dynamic testing is performed and verifies that pile driving resistances will produce stresses in the pile within Acceptable ranges. The Contractor shall perform additional testing at no additional cost to the Department.

^cCompressive strength at 28 Days.

501.3.3 Driven Pile Capacity

The nominal pile capacity will generally be the required factored design resistance of the pile divided by the specified AASHTO LRFD resistance factor, unless specified otherwise. The specified AASHTO resistance factor depends on the specified pile testing and the specified method for monitoring the pile capacity. The Contractor shall determine resistance factors in accordance with Table 501.3.3:1, "LRFD Resistance Factors for Driven Piles," unless otherwise specified.

**Table 501.3.3:1
LRFD Resistance Factors for Driven Piles**

Test Method	Capacity Monitoring Method	LRFD Resistance Factor
Static load test	Wave Equation Analysis	0.8
Dynamic load test	Wave Equation Analysis	0.65
None performed	Wave Equation Analysis	0.5
None performed	Dynamic Formula	0.4

In some cases, the required nominal pile capacity shown may be higher than the factored pile design resistance divided by the specified LRFD resistance factor. In these cases, the required nominal pile capacity includes resistance to be encountered penetrating unsuitable layers in addition to the required factored design resistance divided by the specified LRFD resistance factor.

501.3.3.1 Determination of Pile Capacity with Impact Hammer

501.3.3.1.1 Wave Equation Analysis

The State Geotechnical Engineer will determine the nominal pile capacity based on a Wave Equation Analysis.

The Contractor shall drive piles to the required resistance based on the operating energy of the hammer. The *Pile Driving Acceptance Chart* will indicate the resistance criteria.

The Contractor shall obtain pile penetration by achieving the Wave Equation resistance criteria in accordance with Section 501.3.6.2, "Minimum Penetration Elevation," and Section 501.3.6.3, "Estimated Penetration Elevation." If the predicted pile penetration varies from the Plan length by $\pm 25\%$ or more, the State Geotechnical Engineer will perform a revised Wave Equation Analysis in accordance with Section 501.3.5.2, "Revised Wave Equation Analysis."

501.3.3.1.2 Dynamic Formula

The Contractor shall use the dynamic formula to determine nominal pile capacity only if specified or approved by the State Geotechnical Engineer. The Contractor shall drive piles to the depth necessary to obtain the nominal pile capacity according to the following equation and in accordance with Section 501.3.6.2, "Minimum Penetration Elevation:"

$$R_n = 2 \times F \times E \times \ln(10N) \quad (1)$$

Where,

R_n = nominal bearing resistance, (kips)

F = a constant that varies with hammer and pile type

Air/Steam hammers; all piles $F = 1.8$

Open ended diesel hammers with concrete $F = 1.2$

Open ended diesel hammers with steel piles $F = 1.6$

Closed ended diesel hammers $F = 1.2$

E = developed energy (ft-kips)

N = average penetration resistance in blows per inch for the last four (4) inches of driving

501.3.4 Preparation for Driving

501.3.4.1 Abutment Piles

Unless otherwise shown, and before driving the abutment bearing piles, the Contractor shall place and compact the approach Embankment Material underneath and adjacent to the abutment to the required density. After compaction, the Contractor shall ensure that the surface of the approach Embankment is not lower than the elevation of the bottom of the abutment.

501.3.4.2 Pre-Boring

If specified, the Contractor shall pre-bore holes at pile locations to the depths and size in accordance with the Plans. If the Contract does not specify pre-bored, but the State Geotechnical Engineer approves the use of pre-bored holes, the Contractor shall drill the holes to the depth established by the State Geotechnical Engineer. The Contractor shall ensure that the depth permits the piles to be driven to the minimum penetration elevation and required bearing capacity without overstress or damage to the piles. The Contractor shall pre-bore holes in the presence of the Inspector. After placing pile, the Contractor shall fill voids remaining around the pile with sand or other approved Material.

501.3.4.2.1 Application of Pre-Bored Holes

The Contractor shall only use pre-bored holes as specified, or when demonstrated to the satisfaction of the State Geotechnical Engineer that a pile cannot be driven to the minimum penetration elevation in accordance with Section 501.3.6.2, "Minimum Penetration Elevation."

The Department will determine the need for pre-bored pile holes based on the following driving resistances:

1. Steel piles: when, in ten (10) blows, the set is less than 3/4 inch with the hammer delivering the minimum energy required;
2. Pre-cast concrete piles: when, in ten (10) blows, the set is less than one (1) inch with the hammer delivering the minimum energy as required in the Contract; and
3. All piles: if the resistance is sufficient to overstress the pile as indicated by the Wave Equation Analysis Field Acceptance Chart for the approved hammer system.

501.3.4.2.2 Diameter of Pre-bored Holes

The State Geotechnical Engineer will establish the diameter of pre-bored holes. In general, the diameter established will be as shown in Table 501.3.4.2.5:1, "Diameter of Pre-Bored Holes in Soil," or Table 501.3.4.2.5:2, "Diameter of Pre-Bored Holes in Rock, Shale, or Conglomerate."

501.3.4.2.3 Obstructions

If the Contractor encounters subsurface obstructions, the Contractor may increase the borehole diameter to the smallest dimension adequate for pile installation. The Contractor shall penetrate obstructions in accordance with Section 502.3.5.2.2, "Obstructions."

501.3.4.2.4 Rock Sockets

If the Contract requires the Contractor to drive a pile in a rock socket and the bore hole is larger than the diameter of the pile, the Contractor shall fill around that part of the pile in solid Material with Class G concrete. The Contractor shall place concrete in accordance with Section 502.3, "Construction Requirements." The Contractor shall fill the part of the pile above the rock socket with sand or other suitable Material.

501.3.4.2.5 Temporary Casing

Temporary casing may be required if the soil sloughs or caves into the hole or if a hole is required to be kept dry from groundwater, such as socketed holes into shale. The Contractor shall increase the diameter of the drilled hole as necessary to place the temporary casing. The Contractor shall pull the casing after driving the pile and after the hole is backfilled with

the appropriate Material.

Table 501.3.4.2.5:1
Diameter of Pre-Bored Holes in Soil

Pile type	Diameter
Cylindrical concrete and pipe piles	two (2) inch smaller than the outside pile diameter
Square concrete piles	Minimum pile width
H-piles	two (2) inch smaller than the diagonal measurement of pile

Table 501.3.4.2.5:2
Diameter of Pre-Bored Holes in Rock, Shale, or Conglomerate

Pile type	Diameter
Cylindrical concrete and pipe piles	Outside pile diameter
Square concrete piles and H-piles	Diagonal measurement of pile

501.3.4.3 Pile and Hammer Cushion Preparation

Before the drive head is attached, the Contractor shall make the pile heads plane and perpendicular to the longitudinal axis of the pile. The Contractor shall protect pre-cast concrete pile heads with a pile cushion in accordance with Section 501.3.2.2.3, "Pile Cushion." The Contractor shall provide a new pile cushion for each pre-cast concrete pile. The Contractor shall replace the pile cushion if it is either compressed more than one-half of the original thickness or begins to burn during driving.

The Contractor shall inspect the hammer cushion with the Inspector present when beginning pile driving at each Structure or after each 100 h of pile driving, whichever is less. If the hammer cushion thickness is reduced by more than 25% of the original thickness, the Contractor shall replace the cushion before proceeding with driving.

501.3.4.4 Conditions to Proceed

The Contractor shall not drive production piles until it meets the following conditions:

1. The State Geotechnical Engineer approves the driving system in accordance with Section 501.3.2.4, "Approval of Driving System;"
2. The Inspector completes the *Pile Driving Field Inspection Form* and the form is then approved by the Project Manager;
3. All required load testing is complete as specified and in accordance with Section 504, "Load Testing of Bearing Piles;" Project Manager may approve driving production piles in a foundation element upon satisfactory completion of a load test prior to completion of remaining load tests;
4. The *Pile Driving Acceptance Chart* is completed and stamped with New Mexico P.E. seal by the State Geotechnical Engineer and approved by the State Geotechnical Engineer and submitted to the Project Manager;
5. The hammer and leads are aligned with the pile plan in vertical or battered position; and
6. The Inspector is present before beginning operations.

501.3.5 Variations of Approved Driving Systems

The Contractor shall only use the approved pile driving system. The Contractor shall submit a new *Pile and Driving Equipment Data Form* to the Project Manager for variations to the approved driving system. The Project Manager will notify the Contractor of Acceptance or rejection within 72 h of the receipt of the data form. The time required for submission, review, and approval of a variation in the driving system will not constitute a basis for a Contract Time extension.

501.3.5.1 Variations Due to Dynamic Testing

The State Geotechnical Engineer will reject the hammer if the hammer is unable to transfer sufficient energy to perform the dynamic testing in accordance with Section 504, "Load Testing of Bearing Piles." Reasons for rejection include pre-ignition from overheating or malfunctioning of the injection system and poor hammer or capblock maintenance. After rejection, the Contractor shall repair or replace the hammer.

501.3.5.2 Revised Wave Equation Analysis

The Department will perform a revised Wave Equation Analysis to establish revised driving resistance criteria when the following conditions occur:

1. Variations in the driving system;
2. Pre-boring not originally specified in the Contract is used to facilitate pile penetration; or
3. The pile penetrations are considerably more or less than that estimated in the Contract.

The Contractor shall not drive piles until the Project Manager receives the revised Pile Acceptance Chart.

501.3.6 Pile Driving Operations

Approval of a pile hammer relative to allowable driving stresses will not relieve the Contractor of responsibility for damaged piles for the following reasons:

1. Misalignment of the leads;
2. Failure of capblock or cushion Material;
3. Failure of splices;
4. Malfunctioning of the pile hammer; or
5. Other improper construction methods.

If the State Geotechnical Engineer determines that damage caused by one (1) of the above reasons impairs the pile strength, or questions the measured resistance, the Contractor shall replace the piles at no additional cost to the Department.

The Contractor shall schedule pile driving to prevent vibrations and pressure from damaging piles or other in-place concrete structural components that have reached their initial set, but that do not have sufficient strength to resist damage.

The Contractor shall replace the hammer cushion and pile cushion when necessary in accordance with Section 501.3.4.3, "Pile and Hammer Cushion Preparation," to avoid excessive compression or damage.

501.3.6.1 Pile Measurement and Recording

The Contractor shall ensure that the first pile driven at each Substructure element is accessible so the Inspector can measure and mark the pile in 12-inch increments. On the first pile driven, the Inspector will record blows per 12 inches of penetration until the pile tip is within five (5) ft of the specified penetration elevation or until the pile begins to set up, whichever comes first. Then, the Inspector will measure and record the penetration in inches per ten (10) or 20 blows, as directed by the State Geotechnical Engineer, until the Contractor achieves the specified set.

501.3.6.2 Minimum Penetration Elevation

If the Contract specifies a "Minimum Penetration Elevation" and the driven piles do not develop the required nominal bearing capacity at that elevation, the Contractor shall continue driving the piles until the required resistance is obtained. If the piles develop a set, determined in accordance with Section 501.3.4.2.3, "Application of Pre-Bored Holes," before the pile tip reaches the minimum penetration elevation, the Contractor shall perform drilling to prevent damaging the pile while driving to the minimum penetration elevation.

501.3.6.3 Estimated Penetration Elevation

If the Contract specifies an estimated penetration elevation, the Contractor shall drive the piles to the required nominal capacity. If the piles attain the required resistance above the estimated penetration elevation, the Contractor shall terminate driving and the Department will Accept the piles at the shallower penetration.

501.3.6.4 Pile Groups

If driving multiple rows of piles for pile cap foundations, the Contractor shall drive the piles to the estimated or minimum penetration elevation, before determining pile capacity for Acceptance. After driving the piles in the group to the required tip elevation, the Contractor shall re-strike to determine the pile nominal capacity. If the piles do not develop the required nominal bearing capacity at that elevation, the Contractor shall continue to drive until the required resistance is attained.

501.3.6.5 Splices

The Contractor shall ensure that steel pile splices are in accordance with Section 541, "Steel Structures." The Contractor shall make splices for closed-end pipe piles watertight.

The Contractor shall use the cement dowel method to make splices for pre-cast concrete piles unless the State Geotechnical Engineer approves an alternate splice detail. The Contractor shall select mechanical splices for concrete or steel piles from the Department's *Approved Products List*.

501.3.6.6 Cut-Off Lengths

The Contractor shall cut off the tops of all permanent piles at the elevation shown or as directed. The Contractor shall remove the cut off lengths from the Project.

501.3.6.7 Filling Closed-End Pipe Piles

After driving closed-end steel-pipe piles, the Contractor shall inspect for water or other Deleterious Material inside the piles. The Contractor shall remove water and foreign substances from inside the piles. After the Project Manager approves the piles, the Contractor shall fill them with Class A (any risk zone) concrete with a 4 1/2 inch to eight (8) inch slump. The Contractor shall provide a superplasticizer in accordance with Section 510.3.4.4,

"Superplasticizers" from the Department's *Approved Products List* to achieve the slump. The Contractor shall place the concrete in accordance with Section 502.3.4.4, "Concrete Placement."

501.3.6.8 Filling Open-End Pipe Piles

After driving open-end steel pipe piles, the Contractor shall inspect for water inside the piles. If water is present, the Contractor shall place pea gravel in the pile to an elevation of three (3) feet above the water level. If the Project Manager approves the piles, the Contractor shall fill them with Class A (any risk zone) concrete with a 4 ½ inch to six (6) inch slump. The Contractor shall provide a superplasticizer in accordance with Section 510.3.4.4, "Superplasticizers" from the Department's *Approved Products List* to achieve the slump. The Contractor shall place the concrete in at least the upper ten (10) ft of the piles in accordance with Section 502.3.5.4, "Concrete Placement."

501.3.7 Pile Acceptance

501.3.7.1 Pile Load Capacity and Penetration

The Contractor shall drive piles to the required nominal capacity as determined by the specified capacity monitoring method in accordance with Section 501.3.3, "Driven Pile Capacity."

If specified, the Contractor shall install piles to the penetration elevation in accordance with Section 501.3.6.2, "Minimum Penetration Elevation."

501.3.7.2 Location and Alignment Tolerances

The Contractor shall not pull laterally on piles to correct misalignment or splice a properly aligned section on a misaligned section to meet tolerances.

501.3.7.2.1 Trestle and Abutment Beam Piling

The Contractor shall drive trestle piling and abutment beam piling with a maximum variation of 1/4 inch per foot from the vertical or batter shown. The pile variance will be no more than three (3) inches from the Plan position at any point along its length.

501.3.7.2.2 Foundation Piling

The Contractor shall drive foundation piling capped below grade with a maximum variation of 1/4 inch per foot from the vertical or batter shown, with the tops of the piles at cut off elevation varying no more than three (3) inches from the Plan position.

501.3.7.2.3 Edge Distance

The Contractor shall not place piles within nine (9) inches of an edge of a cap or beam. The Contractor shall increase the size of the cap or beam to meet this edge distance requirement at no additional cost to the Department.

501.3.7.2.4 Pile Orientation

The Contractor shall ensure that H-piles do not rotate more than 15° out of Plan orientation of the strong axis and weak axis of the pile shown.

501.3.7.2.5 Pile Tops

The Contractor shall cut off the tops of piles perpendicular to the longitudinal axis of the pile or to a specified bevel, and within the specified tolerance.

501.3.7.3 Damaged Pile Limitations

The Department will reject damaged piles based on the following criteria:

1. Piles that are broken, cracked, or split;
2. Pre-cast concrete piles that show signs of crushing and spalling of the concrete, splitting, or visible cracks that affect the strength or service life of the pile;
3. Steel piles bent or deformed during installation and exceed mill tolerances for sweep and camber; or
4. Closed-end pipe piles that show evidence of groundwater infiltration, or breaks or deformation that would impair the strength of the completed piles.

501.3.7.4 Correcting Rejected Piles

The Contractor shall correct piles damaged during driving because of internal defects or improper driving with methods approved by the Project Manager, at no additional cost to the Department.

If the Contractor exceeds the location or alignment tolerances, and the State Geotechnical Engineer determines that corrective measures are necessary, the Contractor shall design and construct corrective measures at no additional cost to the Department. The State Geotechnical Engineer will approve the design.

Corrective methods may include the following:

1. Removing and replacing the pile with a new, and when necessary, longer pile;
2. Driving additional piles next to the defective piles; or
3. Extending the footing to properly embed the pile.

501.4 METHOD OF MEASUREMENT

501.4.1 Pile Extensions

The Project Manager will include any approved extension lengths in the pile measurement.

501.4.2 Driven Piles

The Department will measure *Driven Piles* below the cut-off elevation to the nearest foot.

501.4.3 Pile Cut-Offs

The Department will calculate *Pile Cut-Offs* to the nearest foot by subtracting the total lengths of the in-place piles (after cut-off) from the total Plan lengths.

501.4.4 Pre-bored Holes for Driven Piles

The Department will only measure that portion of *Pre-Bored Holes for Driven Piles* below the Plan grade elevation. The Department will not measure that portion of pre-bored holes drilled through soil or rock layers (overburden) that the Contractor later excavates.

501.4.5 Pile Splices

The Department will measure *Pile Splices* required for piles driven deeper than the estimated penetration elevation to achieve the required nominal capacity. The Department will only measure up to two (2) splices per pile in order to drive the piles beyond the specified penetration elevation to meet the required resistance.

501.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Driven Piles (type)</i>	Linear Foot
<i>Pre-bored Holes for Driven Piles, ___in diameter</i>	Linear Foot
<i>Pile Splices</i>	Each
<i>Pile Shoes</i>	Each
<i>Pile Cut-Offs</i>	Linear Foot

501.5.1 Work Included In Payment

The following Work will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Extra length pile used as a follower;
2. Material and backfill placement for pre-bored holes for driven piles, including Class G concrete in rock sockets;
3. Temporary casing and oversizing of pre-bored holes to accommodate temporary casing;
4. Steel reinforcement required in steel pipe piles filled with concrete;
5. Furnishing and driving pile to replace piles which were previously Accepted by the Project Manager and are subsequently damaged through improper handling, driving, or construction operations prior to completion of the Contract;
6. Increases to the Contract quantity of pre-bored holes for driven piles which are not called for in the Contract, but are approved by the State Geotechnical Engineer, will be paid for at a negotiated unit price per foot as established by the Project Manager;
7. Piles that have been driven or partially driven and are subsequently rejected by the Project Manager and are pulled or left in place;
8. Class A concrete and placement in pipe piles;
9. Mobilization and time lost due to re-mobilization of new hammer due to poor hammer performance or as determined by dynamic testing;
10. Re-striking of piles in pile groups to determine pile capacity; and
11. Pile splices provided within the Plan pile length.

SECTION 502: DRILLED SHAFTS

502.1 DESCRIPTION

This Work consists of constructing drilled shafts. Drilled shaft construction, with or without under-reamed bottoms ("bell bottoms"), includes excavation, bottom hole cleaning, reinforcing steel placement and concrete.

502.1.1 Work Experience

The Contractor shall demonstrate to the State Geotechnical Engineer that the Contractor is able to perform the Work in accordance with the Contract. The Contractor shall provide evidence of two (2) Projects within two (2) years of the Bid date involving drilled shaft construction for the conditions expected and use a Superintendent with experience from one (1) of those Projects who will provide all oversight responsibility of all aspects of drilled shaft construction covered in Section 502, "Drilled Shafts." The Contractor shall provide the latest NMDOT drilled shaft inspection form of each drilled shaft element signed by the Drilled Shaft Superintendent indicating drilled shaft construction completed in accordance with Section 502, "Drilled Shaft" requirements.

502.1.2 Geotechnical Data Information

Project *Foundation and/or Geotechnical Reports* include subsurface conditions present at the time of field investigation. The Contractor shall use this information to anticipate conditions that include but are not limited to subsurface water, obstructions, soil stability, and presence of rock.

If Foundation and/or Geotechnical Report information is unavailable, the Contractor shall assume the Casing Construction Method and/or the Slurry Displacement Construction Method referenced in 502.3.4, "Construction Preparations."

502.1.3 Submittals

The Contractor shall submit construction and field designs to the Project Manager for review and approval by the State Geotechnical Engineer. 30 Days shall be allowed for submittal review, 14 additional Days shall be allowed for resubmittal review.

502.2 MATERIALS

502.2.1 General

The Contractor shall provide Materials in accordance with Table 502.2.1:1, "Applicable Drilled Shaft Standards."

**Table 502.2.1:1
Applicable Drilled Shaft Standards**

Material description	Standard
Portland cement concrete, Class G	Section 510, "Portland Cement Concrete"
Reinforcing steel cage	Section 540, "Steel Structures"
Reinforcing steel HP pile	ASTM A 572, Grade 50
Steel pipe (longitudinal or continuous spiral welded) piles and columns	ASTM A 252, Grade 3

502.2.2 Additional Requirements

502.2.2.1 Concrete

For Class G concrete requirements see Section 509, "Portland Cement Concrete Mix Designs."

502.2.2.2 Temporary Casings

The Contractor shall provide temporary steel casings with an inside diameter equal to or greater than the shaft size in accordance with the Contract. The Contractor shall ensure the casings are smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses, pressures of concrete, and the surrounding soils.

502.2.2.3 Permanent Casings

The Contractor shall provide permanent casing with a wall thickness that is at least the thickness specified for the shaft construction. The Contractor shall provide a greater wall thickness if necessary to withstand handling and installation stresses. The casing dimensions are subject to the American Pipe Institute tolerances applicable to regular steel pipe. If approved by the Project Manager, the Contractor may use casings larger than specified, at no additional cost to the Department.

502.3 CONSTRUCTION REQUIREMENTS

502.3.1 Pre-Drilled Shaft Conference

The Project Manager will hold a Pre-Drilled Shaft Conference at least seven (7) Days before the anticipated drilling begins to review the Specification requirements and discuss the Contractor's preparations.

The recommended conference agenda is available from the State Geotechnical Engineer.

502.3.2 Equipment

502.3.2.1 Excavation and Drilling Equipment

The Contractor shall use excavation and drilling Equipment that can excavate a hole of the specified diameter 20% deeper than what is shown in the Contract. The Contractor shall use excavation Equipment that can complete a flat shaft bottom. The Contractor shall ensure that the cutting edges are normal to the vertical axis of the Equipment within a tolerance of 0.25 inch per foot of diameter. The Contractor shall ensure that under-reaming tools do not allow the base diameter to exceed three (3) times the specified shaft diameter. The State Geotechnical Engineer may approve a change in other under-reaming Plan dimensions to accommodate the Equipment. When the State Geotechnical Engineer requires over-reaming of the shaft sidewall, the Contractor shall use an over-reaming bucket, grooving tool, or other approved Equipment. The Contractor shall use an over-reaming tool that over sizes the shaft diameter from 0.5 inch to three (3) inches. If the Contractor cannot drill the Material with conventional earth augers, the Contractor shall use special drilling Equipment, such as core barrels, rock tools and other Equipment, as necessary. Blasting is not allowed.

502.3.2.2 Slurry Equipment

The Contractor shall use desanding Equipment to keep the slurry sand content to less

than eight percent (8%) by volume for mineral slurry and less than one percent (1%) by volume for polymer slurry. This is required during shaft excavation to maintain mix consistency of the slurry in the shaft. The Contractor shall use slurry tanks for slurry circulation, storage, and treatment. The Contractor shall not use excavated slurry pits in place of slurry tanks without the written permission of the Project Manager. The Contractor shall use a slurry-sampling tool to conduct the slurry control tests in accordance with Section 502.3.4.1.3.3, "Slurry Control Tests." The Contractor shall use a slurry sampler capable of sampling slurry from the bottom of the hole and withdrawing the sample without loss or contamination of sample fluid.

502.3.2.3 Concrete Placement Equipment

Depending on the type of shaft construction method, the Contractor shall place the concrete in the excavated shaft with a rigid tremie pipe, a concrete pump line, or a drop chute.

502.3.2.3.1 Tremies

The Contractor shall use a rigid tremie pipe that can deposit concrete at the shaft bottom. The Contractor shall not use a tremie with aluminum parts that will have contact with the concrete. The Contractor shall ensure the inside diameter is at least ten (10) inches. The Contractor shall ensure the tremie's inside and outside surfaces are clean and smooth. The Contractor shall ensure that the tremie is watertight. In slurry displacement shafts, the Contractor shall use a plug initially placed at the top of the tremie to separate the concrete from the displacement fluid until the concrete is flowing through the orifice. The Contractor shall ensure that plugs left in the shaft concrete are made of Material approved by the Project Manager. The Contractor shall construct the discharge end of the tremie to permit the free radial flow of concrete during placement operations.

502.3.2.3.2 Concrete Pumps and Lines

The Contractor shall use watertight pump lines with a diameter of at least five (5) inches. The Contractor shall use schedule-40 steel pipe or heavier. The Contractor shall use plugs in accordance with Section 502.3.2.3.1, "Tremies."

502.3.2.3.3 Drop Chutes

The Contractor shall use rigid-pipe drop chutes that are either one (1) piece or sectional. The Contractor shall ensure they can be added and removed from a metal hopper. The Contractor shall not use flexible trunk line hose.

502.3.3 Submittals

The Contractor shall provide the required drilled shaft submittals to the Project Manager for the State Geotechnical Engineer's review and approval. The Contractor may use documented Work experience (per Section 502.3.3.1, "Work Experience") and proposed construction procedure submittals (per Section 502.3.3.2, "Proposed Construction Procedure") approved on previous Department Projects of similar size, difficulty, and geology, in lieu of the detailed submittal requirements listed below.

Administrative approvals are subject to field verification of performance.

502.3.3.1 Work Experience

The Contractor shall submit documentation verifying the required Work experience in accordance with Section 502.1.1, "Work Experience." The Contractor shall include the names

and phone numbers of references that can verify successful completion of the listed Projects.

502.3.3.2 Proposed Construction Procedure

At least 30 Days before the drilled shaft Work begins, the Contractor shall submit a complete written proposal of the construction procedure. The following information is required:

1. Superintendent name and experience record;
2. List of proposed Equipment including: cranes, drills, augers, bailing buckets, final cleaning Equipment, desanding Equipment, slurry pumps, core sampling Equipment, tremies or concrete pumps, casing, etc.;
3. Description of construction operation sequence;
4. Description of shaft excavation methods;
5. Details of mixing, circulating, and slurry desanding methods;
6. Manufacturer and type of apparatus for testing slurry;
7. Description of methods for cleaning the shaft excavation;
8. Description of methods for dewatering shaft excavation;
9. Description of methods for managing caving or unstable zones within the shaft excavation;
10. Details for placing reinforcement including support and centralization methods; and
11. Details for placing concrete including operational procedures for free fall, tremie or pumping methods.

502.3.4 Construction Preparations

502.3.4.1 Site and Subsurface Conditions

The Department's test results and rock core samples are available for examination upon request.

502.3.4.2 Protection of Existing Structures

If specified in the Contract, the Contractor shall submit a preventative-measures Plan to the Project Manager, at least 14 Days before the construction of the shaft.

502.3.4.3 Site Preparation

If footings are present, the Contractor shall excavate to the footings' bottom elevation before beginning shaft construction, unless the Contract or Project Manager allows otherwise. If the Contractor drills shafts in conjunction with placing Embankment, the Contractor shall drill the shafts after placing the fill, unless the Contract or Project Manager allows otherwise.

502.3.4.4 Proof Drilled Shafts

The Contractor shall construct a proof drilled shaft, when specified in the Contract, at the location shown in the Plans. The Contractor shall construct the shaft after the State Geotechnical Engineer approves the Equipment and methods. If specified in the Contract, the Contractor shall load test the proof shaft in accordance with the Contract and Section 504, "Load Testing of Bearing Piles." The Contractor shall drill the shaft to the maximum depth of any production shaft unless otherwise shown in the Contract. If specified in the Contract, the Contractor shall under-ream the proof shaft to establish the feasibility of under-reaming in a specific soil strata or rock. The Contractor shall fill the proof shaft with concrete in the same

way as the production shafts. If the methods and Equipment produce inadequate results as determined in 502.3.8, "Acceptance," the Project Manager will require the Contractor to demonstrate Acceptable results with another proof shaft. Once the proof shaft is approved, the Contractor shall construct production shafts using the same means and methods. The Contractor shall not change the means or methods without written approval from the State Geotechnical Engineer. The Contractor shall cut off the proof shafts five (5) ft below finished grade and leave in place. The Contractor shall restore the proof shaft sites to their original condition.

502.3.5 Construction of Drilled Shafts

502.3.5.1 Construction Methods

502.3.5.1.1 Dry Construction Method

The dry method consists of the following:

1. Drilling the shaft;
2. Removing accumulated water and loose Material from the excavation;
3. Testing and approving bottom hole conditions by Project Manager;
4. Placing the reinforcing cage; and
5. Concreting the shaft.

The State Geotechnical Engineer will approve the dry construction method in accordance with the Proposed Construction Procedure submittal when the following occurs:

1. The shaft accumulates less than 12 inches of water above the base over a one (1) hr period without pumping;
2. The shaft remains stable without caving, sloughing or swelling over a four (4) hr period immediately following excavation;
3. The Contractor can remove loose Material and water before inspection and concrete placement; and
4. Use of low strength grout collars to stabilize running sands or unstable zones within the drilled shaft excavation.

The Contractor's Proposed Construction Procedure submittal shall include the use of the slurry-displacement construction method or the casing construction method for shafts that do not meet these requirements.

502.3.5.1.2 Casing Construction Method

The Contractor shall use the casing construction method when called for in the Contract or where the dry construction method is inadequate. If necessary, the Contractor shall use the casing method combined with the slurry displacement or dry construction method. The Contractor shall place the casing by twisting, driving, or vibrating into the ground before cleaning it out, unless the Contract requires the Contractor to place the casing in a predrilled hole. If the Contractor elects to use casings or shafts larger than those specified, the Contractor shall provide the concrete necessary to fill the additional volume, at no additional cost to the Department.

502.3.5.1.2.1 Temporary Casing

The Department will consider subsurface casing to be temporary unless shown as permanent in the Contract. The Contractor shall remove the temporary casing when placing

concrete for the drilled shaft when the concrete is in a fluid state. If the Contractor removes a casing or replaces it with a longer or larger diameter casing through caving soils, the Contractor shall stabilize the excavation with slurry before installing the new casing. Other methods to control the stability of an excavation require approval of the State Geotechnical Engineer. Before withdrawing the casing, the Contractor shall ensure that the level of concrete in the casing is at least ten (10) ft above either the hydrostatic water level or the drilling fluid level, whichever is higher. The Contractor shall maintain a concrete level in the casing as it is removed so that fluid trapped behind it is displaced upward and discharged without contaminating or displacing the shaft concrete. Temporary casings that become bound or fouled during shaft construction, and cannot be practically removed, constitute a defect. The Contractor shall repair defective shafts in accordance with 502.3.9, "Correction of Defective Drilled Shafts."

502.3.5.1.2.2 Permanent Casing

The Contractor shall make permanent casing continuous from top to bottom. The Contractor shall cut off the permanent casing at the prescribed elevation after installation. The Contractor shall complete the shaft by placing the reinforcing steel and concrete in the casing. If using temporary casings in conjunction with permanent casings, the Contractor shall keep the temporary inner casing aligned with the permanent outer casing. The Contractor shall maintain a water-tight seal between the two (2) casings during excavation and concrete placement where an oversized hole or temporary casing is approved by the Project Manager. When approved by the State Geotechnical Engineer to allow drilling an oversize hole to aid in the placement of the permanent casing, the Contractor shall post grout the exterior annular space outside of the permanent casing, such that the direct contact between casing and the surrounding soil/rock is created.

502.3.5.1.3 Slurry Displacement Construction Method

The Contractor shall use the slurry displacement method at sites where maintaining a dry excavation is not possible. The Contractor shall use a mineral or polymer slurry, or water to maintain stability around the hole's perimeter while advancing excavating, placing the reinforcing cage, and placing concrete. The Contractor shall displace the slurry during final cleaning of the excavation with a bailing bucket, air lift, or submersible pump. The Contractor shall place concrete with a tremie or concrete pump beginning at the shaft bottom. During construction, the Contractor shall keep the slurry level in the shaft excavation high enough to prevent caving and at least five (5) ft above the highest expected piezometric pressure head along the depth of the shaft. If not using permanent casings, the Contractor shall provide temporary surface casings to aid shaft alignment and to prevent sloughing, unless otherwise approved by the State Geotechnical Engineer. If the slurry construction method does not produce the necessary results, the Contractor shall discontinue operations and make corrective modifications to the procedures and Equipment.

502.3.5.1.3.1 Polymer Slurry Requirements

The Contractor shall use polymer slurry that will stabilize the hole and inhibit the influx of ground water. Table 502.3.4.1.3.1:1, "Polymer Slurry Requirements, Emulsified or Dry partially hydrolyzed polyacrylamide (PHPA) Polymer," lists Acceptable ranges of values for slurry viscosity and gel.

**Table 502.3.5.1.3.1:1
Polymer Slurry Requirements, Emulsified or Dry PHPA Polymer**

Property (units)	Requirements (at time of introduction or before concreting)	Test Method
Density (pcf)	62.4 – 64.0	Density Balance
Viscosity (seconds/quart)	50–120	Marsh Funnel
pH	8–11.7	pH Paper
Sand Content (% by volume)	0–1	API Method

Note: Perform tests when the slurry temperature is above 40 °F.

The Contractor shall premix the polymer slurry according to the manufacturer's directions. The Contractor shall prevent the slurry from losing the required viscosity and gel characteristics in the shaft.

The Contractor shall neutralize expended polymer slurry with bleach or in accordance with the manufacturer's recommendations and dispose of it in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public."

502.3.5.1.3.2 Mineral Slurry Requirements

The Contractor shall use attapulgite, in lieu of bentonite, where saline or chemically contaminated groundwater occurs. The Contractor shall use mineral slurry with a grain size that remains in suspension and has sufficient viscosity and gel characteristics to transport excavated Material to the screening system. The Contractor shall provide mineral slurry in accordance with Table 502.3.5.1.3.2:1, "Mineral Slurry Requirements, Sodium Bentonite or Attapulgite in Fresh Water."

**Table 502.3.5.1.3.2:1
Mineral Slurry Requirements, Sodium Bentonite or Attapulgite in Fresh Water**

Property (units)	At time of slurry introduction	In hole at time of concreting	Test method
Density (pcf)	N/A	64.0 – 75.0	Density Balance
Viscosity (seconds/quart)	28–45	N/A	Marsh Cone
PH	8–10	8–10	pH paper
Sand Content	N/A	0–4	API Method

Note: Perform tests when the slurry temperature is above 40 °F.

The Contractor shall premix the slurry according to the manufacturer's directions. The Contractor shall prevent the slurry from "setting up" in the shaft. The Contractor shall dispose of the slurry offsite in accordance with Section 107.14.8, "Disposal of Other Materials and Debris."

502.3.5.1.3.3 Slurry Control Tests

The Contractor shall perform control tests on the mineral slurry to determine density, viscosity, pH, and sand content. The Contractor shall not place concrete unless the Project Manager has approved the bottom hole test results and after test results show Acceptable values. The Contractor shall provide test reports to the Project Manager upon completion of each drilled shaft.

502.3.5.1.3.3.1 Pre-entry Tests

The Contractor shall perform tests to determine viscosity and pH before pumping the slurry into the excavation. The Contractor shall take at least two (2) sets of tests during the first eight (8) h of slurry processing. The Contractor shall decrease the testing frequency to one (1) set every eight (8) hours when the results are consistent.

502.3.5.1.3.3.2 Bottom Hole Tests

The Contractor shall test slurry samples taken from the shaft base before placing concrete in any shaft excavation. The Contractor shall test until samples produce Acceptable values for density, pH, and sand content.

502.3.5.2 Shaft Excavation

The Contractor shall extend drilled shaft tip elevations when the State Geotechnical Engineer determines that the Material encountered during excavation is unsuitable. The Contractor shall dispose of Materials from the shaft excavation as directed by the Project Manager.

When using vibrating casing, the Contractor shall not place adjacent casings or excavate shafts until 48 h after pour completion of an adjacent shaft, or when concrete from the adjacent shaft pour breaks at least 2,000 psi, whichever comes first. This requirement applies to excavating any shaft within four (4) shaft diameters measured center to center.

502.3.5.2.1 Under-ream and Over-ream

The Contractor shall use sidewall over-reaming when the State Geotechnical Engineer determines the sidewall has: softened due to excavation methods; swelled due to concrete placement Delays; or, degraded because of slurry cake build-up. The State Geotechnical Engineer will direct the thickness and elevation of sidewall over-reaming.

502.3.5.2.2 Obstructions

The Contractor shall remove surface and subsurface obstructions that are anticipated in the Contract. Obstructions may include manmade Materials, such as old concrete foundations, or natural Materials, such as boulders or nested cobble zones. When unanticipated obstructions are encountered, the Contractor shall notify the Project Manager as shown in Section 502.4.3, "Unanticipated Obstruction Removal."

502.3.5.2.3 Soil Samples and Rock Cores

The Contractor shall take soil samples or rock cores at the locations shown in the Contract or as directed by the State Geotechnical Engineer to determine the character of Material directly below the bottom shaft elevation. The Contractor shall perform soil borings before excavating the shafts. The Contractor shall perform rock cores before excavating the shaft from the bottom of an exploration hole at no additional cost to the Department. The Contractor shall extract and ship the core samples in accordance with the Department's *Manual of Highway Structure Foundation Investigation and Subsurface Exploration*. Unless otherwise specified in the Contract, the Contractor shall begin bore holes or rock cores at the top of the rock socket elevation to at least ten (10) ft below the bottom of the drilled shaft excavation. The Contractor shall record the rock quality designation, percent recovery, joint orientation and infilling, and joint water from the rock cores extracted. After exploration, the Contractor shall fill the core holes with grout, slurry, or mortar having a minimum compressive strength of 3,000 psi at 28 Days. The Contractor shall deliver the geologist's field log cards to the Project Manager after completing the logs. The Department will not require the

Contractor's geotechnical consultant to perform Laboratory testing on soil samples or rock cores unless specifically specified in the Contract. The State Geotechnical Engineer will notify the Contractor of the final required shaft depth after receiving the geologist's field log sheets and the lab testing results. This notification may take as long as 48 h from the time the State Geotechnical Engineer receives the field log sheets or the soil and rock samples test results.

502.3.5.2.4 Shaft Excavation Inspection

The Contractor shall measure the final shaft depths. The Contractor shall ensure that at least 50% of each shaft base has less than one (1.0) inch of sediment when placing the concrete. The Contractor shall ensure that the sediment depth or debris at any place on the shaft base does not exceed 1.5 inches. For dry shafts, the Contractor shall ensure that the water depth does not exceed three (3) inches before pouring concrete. The Contractor shall inspect slurry displacement shafts using the methods that the State Geotechnical Engineer deems appropriate. The Contractor shall receive approval of bottom hole conditions from the Project Manager prior to continuing with the Work.

502.3.5.2.4.1 Inspection Procedures

The Project Manager will notify the Contractor which procedures will be used for the shaft inspections. The Contractor shall supply Equipment and labor for inspection of the shaft. Inspection procedures may include:

1. Inserting a casing in the shaft excavation temporarily for alignment, cleanliness, and dimension checks;
2. Inserting a rigid rod assembly with several 90° offsets equal to the shaft diameter;
3. Using Department video Equipment; or
4. Using a weighted tape and evaluation of results of desanding and density tests for slurry displacement excavations.

502.3.5.2.4.2 Remedial Work for Substandard Excavation

If the State Geotechnical Engineer determines that a shaft excavation is substandard, the Contractor shall develop, propose, and implement corrective measures. Corrective measures may include:

1. Over drilling to a larger diameter to permit reinforcing steel placement with the required minimum cover;
2. Over-reaming sidewalls of the shaft;
3. Increasing steel reinforcement bar number and size; or
4. Enlarging the under-ream within allowed tolerance.

502.3.5.3 Reinforcing Steel Unit Placement

The reinforcing steel unit consists of longitudinal bars and circular ties or a Structural Steel shape. The Contractor shall place the structural shape or the reinforcing steel cage as a unit immediately after the Project Manager approves the shaft excavation and before placing concrete. The Contractor shall tie and support the reinforcing steel unit in the shaft so that it remains within allowable tolerances given in Section 502.3.6, "Location and Alignment Tolerances." The Contractor shall use concrete spacers or other approved non-corrosive spacing devices at sufficient intervals, near the bottom and at maximum intervals of ten (10) ft up the shaft, to ensure concentric spacing for the entire reinforcement unit length. The Contractor shall use spacers equal in quality and durability to the concrete specified for the shaft. The Contractor shall inspect the bottom of the shaft immediately before placing of the

cage to ensure that there is no sloughing.

The Contractor shall check the top elevation of the reinforcement unit before and after placing the concrete. If the reinforcement unit is not maintained within the specified tolerances, the Contractor shall make corrections. The Contractor shall not construct additional shafts before modifying the reinforcement unit support to the satisfaction of the Project Manager. The Contractor shall maintain the reinforcement unit at the proper elevation and orientation with an approved support mechanism at the ground surface. The Contractor shall place shaft concrete immediately after installing the cage. If more than 24 h elapses between the placement of the cage and concrete placement, the Contractor shall remove the cage and inspect the shaft for sloughing or other damage.

502.3.5.4 Concrete Placement

The Contractor shall place concrete in accordance with Section 511, "Concrete Structures." The Contractor shall place concrete as soon as possible after placing reinforcing steel.

The Contractor shall ensure that the time from when the concrete is batched at the plant to placement does not exceed two (2) h. The Project Manager may approve a longer time period if the concrete mixture remains workable and plastic. The Contractor shall use admixtures for the job conditions so the concrete remains in a workable plastic state through the approved placement limit.

502.3.5.4.1 Concrete Placement by Free Fall

The Contractor may use free fall placement in a stable shaft where the maximum water depth does not exceed three (3) inches. The Contractor shall ensure that free fall-placed concrete falls directly to the base without contacting either the rebar cage or hole sidewall. The Contractor shall use a hopper at the top of the shaft or a rigid pipe extension from the hopper. The Contractor shall ensure that free fall placement does not exceed 60 ft below the bottom of the hopper or the rigid pipe extension. The Contractor shall not use free fall in slurry displacement shafts. If the Project Manager determines that concrete cannot be placed using the free fall method, the Contractor shall use either a tremie or pump to accomplish the pour.

502.3.5.4.2 Concrete Placement with Tremie or by Pumping

The Contractor shall use rigid tremie pipe and/or concrete pumps for concrete placement in either dry or slurry displacement shafts. The Contractor shall place plug within tremie or pump line to ensure concrete does not segregate prior to developing concrete pressure head within tremie or pump line and that plug does not discharge from tremie or pump line prior to concrete developing continuous flow. The Contractor shall not begin underwater placement before placing the tremie or pump line within one (1) tremie or pump line diameter of the shaft base elevation. The Contractor shall remove plugs from the excavation if the Project Manager does not specifically approve them to remain in the shaft. The Contractor shall keep the discharge end continually immersed at least five (5) ft in concrete after starting the flow of concrete. The Contractor shall keep the concrete flow continuous. The Contractor shall maintain the concrete in tremies or pump lines continuously at a positive pressure differential to prevent water or slurry intrusion into the shaft concrete. When lifting pump lines during concrete placement; the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation. If at any time during the concrete pour, the orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the Department will consider the shaft defective. The Contractor may at its own risk and cost, remove the reinforcing cage and concrete to complete the necessary sidewall removal as directed by the State Geotechnical Engineer. The Department will base

Final Acceptance in accordance with Section 502.3.8, "Acceptance."

502.3.6 Location and Alignment Tolerances

The Contractor shall adhere to the following construction tolerances unless otherwise stated in the Contract:

1. Ensure the drilled shaft and the concentric reinforcement steel unit is within three (3) inches of the position shown on the Plans at the top of the shaft;
2. Do not vary the vertical alignment of a vertical drilled shaft from the alignment show on the Plans by more than 1/4 inch per foot of depth. Do not vary alignment of a battered drilled shaft by more than 0.5 inch per foot of depth from the specified batter;
3. Ensure that the top of the reinforcing steel unit is no more than six (6) inches above and no more than three (3) inches below the elevation show on the Plans; and
4. Ensure that the top elevation has a tolerance of plus one (+1) inch or minus three (-3) inches from the top of shaft elevation.

502.3.7 Load Testing

When the Contract includes load testing, the Contractor shall complete the testing before construction of production shafts, unless otherwise approved by the State Geotechnical Engineer. The Contractor shall allow three (3) Working Days after the last load test is completed before receiving tip elevations of the production shafts from the State Geotechnical Engineer and proceeding with the construction of production shafts. After testing is completed, the Contractor shall cut off the test shafts and reaction shafts at an elevation of five (5) ft below the finished ground elevation.

502.3.8 Acceptance

502.3.8.1 Concrete Strength

The Department will Accept drilled shafts in accordance with Section 510.3.5, "Acceptance."

Loads may be placed on the drilled shafts once 75% of compressive strength has been met. In place concrete strength shall be determined in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements."

502.3.8.2 Location and Alignment Tolerances

The Department will Accept drilled shafts if the construction tolerances are satisfied in accordance with Section 502.3.6, "Location and Alignment Tolerances." If the shafts exceed the location or alignment tolerances, the Department will reject the shafts. If the State Geotechnical Engineer determines that the extent of overloading is not detrimental to the performance of the shaft, the Department will accept the shaft.

502.3.8.3 Shaft Integrity

If applicable, the Department will Accept shafts when the pile integrity testing reports verify the structural integrity of the piles. The Department may reject a shaft if integrity testing shows conclusive evidence that a defect exists in the shaft that may result in inadequate or unsafe performance under service loads. If the report is inconclusive, the State Geotechnical Engineer may require the Contractor to drill a core hole in the shaft. If the core hole confirms

the defect, the Department will not pay the coring costs. If the core hole does not find a defect, the Department will pay for coring costs, including pressure grouting.

502.3.9 Correction of Defective Drilled Shafts

If the Department determines that a shaft is unacceptable, the Contractor shall submit a Plan for remedial action to the Project Manager for approval. The Contractor shall provide calculations and Working Drawings, stamped by a New Mexico licensed professional Engineer for all foundation elements affected by the proposed corrections. The Contractor shall make corrections to drilled shafts at no additional cost to the Department.

502.4 METHOD OF MEASUREMENT

502.4.1 Drilled Shafts

The Department will not measure additional shaft depth or additional shafts used due to defective procedures.

The Department will only measure the first proof shaft constructed in place.

502.4.2 Soil Borings and Rock Cores

The Department will measure *Soil Borings* from the bottom of the exploration hole to existing grade.

The Department will measure Rock Cores from the point at which rock cores are recovered to the bottom of the rock coring.

502.4.3 Unanticipated Obstruction Removal

The Department will measure and pay for obstruction removal only when it is not anticipated in the Contract Documents.

The Department will measure an obstruction vertically beginning where it is encountered and ending where conventional drilling Equipment adequately advances the hole. To qualify for Obstruction Removal measurement, the Contractor shall get the State Geotechnical Engineer's authorization and meet the following requirements:

1. Hole advancement requires special procedures and tools, such as: chisels, boulder breakers, percussion hammers, core barrels, air tools, hand excavation, temporary casing, or increasing hole diameter; or
2. The rate of auger advancement is decreased to where the drilling rate through the obstruction is less than 50% of the drilling rate above the obstruction.

Obstruction Removal cost will include Delay costs. The Department will not allow additional Contract Time unless the Project Manager approves a detailed schedule analysis establishing the Critical Path of the additional time required to complete the Obstruction Removal. The Department will not measure *Obstruction Removal* outside the specified shaft diameter.

502.4.4 Certified Drilled Shaft Inspector

The Contractor shall provide a Certified Drilled Shaft Inspector to oversee and inspect all aspects of the drilled shaft construction and sign the NMDOT Drilled Shaft Inspection Reports. The Contractor shall provide certification through NMDOT TTCP or International Association

of Foundation Drilling, also identified as ADSC.

502.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Drilled Shaft Foundation</i> ____ <i>Diameter</i>	Linear Foot
<i>Permanent Casing</i> ____ <i>Diameter</i>	Linear Foot
<i>Steel Shape Reinforcement</i>	Pound
<i>Soil Borings</i>	Linear Foot
<i>Rock Cores</i>	Linear Foot
<i>Obstruction Removal</i>	Linear Foot

Steel Reinforcement in the drilled shaft is paid for under Section 540, "Steel Reinforcement" except for overhead sign structures which are addressed in Section 701, "Traffic Signs and Sign Structures."

502.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Methods employed by the Contractor to maintain stability of the shaft, including the use of temporary casings, slurry assisted shaft excavation, or use of grout collars;
2. All Work associated with sidewall over-reaming;
3. Drilled shaft concrete required to fill shafts including oversized excavations, under-reams, and over-reams;
4. Excavation of anticipated Materials shown in the Contract of different densities and character, including employment of special tools and procedures necessary to accomplish the excavation through anticipated Materials;
5. Additional wall thickness required for handling and installation of casing;
6. The Equipment and labor required for the shaft inspection procedure; and
7. Certified Drilled Shaft Inspection.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project limits without written approval from the Project Manager.

SECTION 504: LOAD TESTING OF BEARING PILES

504.1 DESCRIPTION

This Work consists of static axial compressive load tests (pile load test), static axial tensile load tests (pile pullout tests), and high strain dynamic measurements (dynamic measurements) of piles for the purpose of determining ultimate bearing capacity and pile pullout capacity.

For driven piles, dynamic measurements determine driving stresses, pile integrity, and hammer efficiency. For cast-in-place concrete piles (drilled shafts), dynamic measurements verify pile integrity.

504.1.1 Contractor's Responsibilities

504.1.1.1 Dynamic Measurements

The Contractor shall provide labor, Equipment, and Materials necessary to drill the dynamic test piles holes and for mounting transducers. The Contractor shall provide the analysis Equipment power supply.

Where dynamic measurements are to be made on cast-in-place piles, the Contractor shall provide a gravity drop hammer and pile cushioning. The Contractor shall excavate around the pile, cut the permanent casing, drill holes in the test pile(s) and provide impacts on cast-in-place dynamic test piles as required.

If a Pile Dynamic Test Consultant Testing is required as designated on the Plans, the consultant's qualifications and Equipment must meet the requirements of this Section and Section 504.3, "Construction Requirements." Pile Dynamic Consultant Equipment must meet the requirements of Section 504.3.1.5, "Pile Driving Analyzer." The Contractor shall perform field Pile Dynamic Testing with an experienced technician or Engineer having at least two (2) years of experience with Pile Dynamic Testing methods. The Contractor shall use a licensed Professional Engineer having at least three (3) years of experience in Pile Dynamic Testing performed to interpret the recorded measurements and generate reports.

At the option of the State Geotechnical Engineer, Department personnel may perform the Pile Dynamic Testing.

504.1.1.2 Pile Load and Pile Pullout Tests

The Contractor shall provide everything necessary to perform pile load or pile pullout tests. The Contractor shall record load measurement and pile movement readings, and produce a report(s) showing the load displacement curve(s).

504.1.2 Department's Responsibilities

504.1.2.1 Dynamic Measurements

If Pile Dynamic Testing performed by the Department is required, as designated on the Plans, the Department will provide the Equipment to perform dynamic measurements and the Department will provide personnel to take the dynamic measurements.

504.1.2.2 Pile Load and Pile Pullout Tests

The Contract will specify the anchor pile requirements. The Department will provide

personnel to observe and monitor the Contractor's test apparatus, test methods, and data collection.

504.1.3 Pile Testing Mobilization

The Contractor shall mobilize testing Equipment as needed and as designated by the Contract or authorized by the State Geotechnical Engineer. The Contractor shall mobilize testing Equipment only after receipt of written authorization.

504.2 MATERIALS

504.2.1 Submittals

504.2.1.1 Load Test Frame

The Contractor shall submit the proposed load test frame and anchorage method, details, and design computations 30 Days before the start of pile load tests and pile pullout tests. The Contractor shall use a professional Engineer licensed in New Mexico to prepare and seal the proposed loading apparatus detail Plans.

504.2.1.2 Certificates of Calibration

The Contractor shall submit a calibration certificate and a calibration chart relating pressure to load for the load pressure gauge(s) from a certified Laboratory before use. The Contractor shall calibrate each jack and its gauge as a unit. The Contractor shall submit a calibration certificate for load cell(s). The Contractor shall calibrate gauges and cells within six (6) months before use.

504.2.1.3 Pile and Equipment Data Form

The Contractor shall submit a *Pile and Driving Equipment Data Form* as required in Section 501.2.3.1, "Pile Driving Equipment Submittals," when proposing a gravity drop hammer for dynamic measurements of cast-in-place piles.

504.3 CONSTRUCTION REQUIREMENTS

504.3.1 Equipment

504.3.1.1 Equipment for Dynamic Testing

504.3.1.1.1 Power Supply

The Contractor shall provide dynamic test Equipment electric power that supplies 10 A, 115 V, 55 Hz to 60 Hz, AC only. If a field generator is used as the power source, the Contractor shall provide functioning voltage and frequency level monitoring meters.

504.3.1.1.2 Gauge Mounting Equipment

The Contractor shall provide a power drill, bits, taps, and expandable masonry anchor studs to drill holes in the dynamic test piles for bolting transducers to the piles. The Contractor shall provide a six (6) lb rubber mallet hammer when dynamic testing is specified on precast concrete piles.

504.3.1.1.3 Personnel Lift

To assist with the installation of instruments for testing, the Contractor shall provide a hydraulic, telescoping arm personnel lift. The Contractor shall provide a personnel lift with adequate length to reach the top of the pile while the pile is located in the leads.

The Contractor may use an alternative to a personnel lift in accordance with Section 504.3.4.1.2, "Preparation for Testing."

504.3.1.1.4 Gravity Drop Hammer

The Contractor shall provide a gravity drop hammer and pile cushion when cast-in-place piles dynamic testing is specified. The Contractor shall provide the minimum hammer ram weight and free fall height and cushion thickness specified in the Contract. The Contractor shall equip gravity hammers with guides to ensure concentric drive head impact.

If approved by the State Geotechnical Engineer, the Contractor may use a diesel hammer with the minimum required ram weight and impact energy. The Contractor shall cut-off the fuel flow.

504.3.1.1.5 Pile Driving Analyzer

The Contractor shall perform the Pile Dynamic Testing using a Pile Driving Analyzer® (PDA) system (Model 8G or PAX) or equivalent. The Dynamic Testing Consultant shall furnish all Equipment necessary for the Pile Dynamic Testing such as sensors, cables or wireless transmitters, etc. The Equipment shall conform to the requirements of ASTM D-4945.

504.3.2 Equipment for Pile Load Test

The Contractor shall provide testing Equipment and measuring systems in accordance with ASTM D 1143, except as modified within these Specifications.

504.3.2.1 Load System

The Contractor shall provide a load system capable of applying 250% of the required ultimate pile capacity. The Contractor shall provide a load test frame design compatible with the anchor pile requirements in accordance with Section 504.3.4.2.1, "Test Pile and Anchor Pile Requirements."

The Contractor shall construct the apparatus so that it is possible to place load increments gradually without causing test pile or load test frame vibration.

504.3.2.2 Load Application System

The Contractor shall use hydraulic jacks to apply the load. When using multiple jacks, fit each jack with a pressure gauge in addition to the master hydraulic pressure gauge. The Contractor shall use jacks from the same manufacturer with the same rated capacity. The Contractor shall connect jacks to a common manifold with pressure supplied by one (1) hydraulic pump.

504.3.2.3 Load Measuring System

The Contractor shall provide a dual load measuring system (gauge and load cell) to verify the test pile load. The Contractor shall calibrate the load cell and mount it between the load frame and the pile head to confirm the load recorded from the pressure gauge.

504.3.2.4 Settlement Measuring System

The Contractor shall use a dual settlement measuring system. The Contractor shall provide two (2) dial gauges bearing on the reference beams at opposite sides of the pile, below the test plate. The Contractor shall support the reference beams outside of pile-soil movement influences. The Contractor shall provide two (2) linear variable differentiating transformers, with remote digital read-outs bearing on reference beams on opposite sides of the pile.

504.3.3 Equipment for Pile Pullout Test

The Contractor shall use testing Equipment and measuring systems in accordance with Section 504.3.2, "Equipment for Pile Load Test," except as modified within these Specifications.

504.3.3.1 Load System

The Contractor shall provide a load system capable of applying 200% of the required ultimate pile pullout capacity.

504.3.3.2 Reaction System

It is permissible to use suitable cribbing or other bearing plates for reaction points instead of anchor piles. The Contractor shall use cribbing or bearing plates of sufficient size and stiffness to limit undesirable reaction frame movement.

504.3.4 Testing Requirements

504.3.4.1 Pre-Construction Wave Equation Analysis

The State Geotechnical Engineer or Dynamic Testing Consultant shall use the submitted information required in Section 501.2.3.1, "Pile Driving Submittals" to perform wave equation analyses and shall prepare a summary report of the wave equation results. The wave equation analysis (using GRLWEAPTTM software by Pile Dynamics, Inc. or equivalent) shall be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses.

Approval of the proposed driving system by the Engineer shall be based upon the wave equation analyses indicating that the proposed driving system meeting the requirements of Section 501.3.1.4, "Approval of Driving System."

A Preliminary Wave Equation Analysis Acceptance Chart shall be developed and submitted to the Project Manager a minimum of seven (7) Days before commencing pile driving. The Contractor shall submit the Preliminary Wave Equation Analysis Acceptance Chart meeting the template requirements as provided by the NMDOT Geotechnical Section.

504.3.4.1.1 Dynamic Pile Testing Requirements

The Contractor shall perform dynamic testing during the pile driving as described in the Contract as "Dynamic Test Piles." The State Geotechnical Engineer may decide to designate additional piles shown in the Contract as dynamic test piles.

504.3.4.1.1.1 Notification to Proceed

The Contractor shall notify the Project Manager at least 21 Days before commencing dynamic test pile testing. The Contractor shall confirm the testing schedule with the Project

Manager three (3) Days before the testing date. The Contractor shall notify the Project Manager promptly of any changes in the schedule. The Contractor shall test dynamic test piles before any other piles are driven or installed. The Contractor shall drive production piles no deeper than the estimated or minimum penetration elevation as applicable before receiving the field Acceptance criteria.

504.3.4.1.2 Preparation for Testing

The Contractor shall prepare dynamic test piles as follows:

1. **Drilling for Mounting Transducers.** Drill holes for mounting the transducers. Bolt the instruments near the head of the pile at the location and using a bolt pattern designated by the State Geotechnical Engineer.

Drilling requirements for each test pile include the following:

- 1.1. Steel pipe piles: Seven (7) holes drilled with a 7/32 inch diameter bit, tapped to accommodate ¼ in bolts;
- 1.2. Steel HP piles: Five (5) holes drilled with a 5/16 inch diameter bit through the web;
- 1.3. Precast concrete or cast-in-place concrete piles: 7 ¼ inch x 1 ½ inch holes with ¼ inch expandable anchor studs set in the holes to accommodate ¼ inch bolts;

2. **Wave Speed Measurements.** When precast concrete piles are specified as dynamic test piles, place the pile horizontally on wooden sleepers so that it is not in contact with the ground or with other piling. The State Geotechnical Engineer will take wave speed measurements for the Pile Driving Analyzer (PDA) by hitting the pile with a six (6) lb rubber mallet hammer.

The Department will not require wave speed measurements for steel piles; and

3. **Transducer Installation.** Install the instruments while the pile is in the leads using a man-lift raised to the top of the pile.

As an alternative to the man-lift requirement, the State Geotechnical Engineer may install the instruments after the pile is driven to a tip elevation of ten (10) ft above the Plan tip elevation.

504.3.4.1.3 Procedure for Testing Driven Piles

The following are the procedures for testing driven piles for either Department or Consultant Pile Dynamic Testing:

1. Drive the test pile in accordance with Section 501.3.5, "Pile Driving Operations," while the State Geotechnical Engineer monitors the dynamic measurements;
2. Monitor the test pile stresses that result from the driving to ensure that the compressive or tensile stresses do not exceed the allowable driving stresses as defined in Table 501.3.1.4:1, "Wave Equation Analysis Allowable Driving Stress." If the monitored pile stresses exceed these criteria, stop driving. Perform necessary modifications to the driving operation to ensure that pile damage does not occur;
3. Monitor the test pile stresses on individual gauges to determine if non-axial driving is indicated. If the pile bends beyond Acceptable allowances, stop driving and realign the driving system;
4. If the Contract specifies an estimated penetration elevation, drive the first dynamic test pile until the required ultimate capacity or the estimated penetration elevation is achieved;

If the Contract specifies a minimum penetration elevation, drive the first dynamic

test pile to that elevation;

If the test pile does not achieve the required ultimate capacity at the estimated or minimum penetration elevation, splice the test pile with additional length of pile. Remove and relocate the instruments to the spliced section. Proceed with driving until the ultimate driving capacity is achieved; and

5. Forty-eight hours after the initial drive, restrike each test pile previously driven with the dynamic measuring Equipment installed. The State Geotechnical Engineer may allow shorter wait periods depending on soil and test conditions. Alternatively, the Contract may require longer wait periods, multiple restrike intervals, or both on a given test pile. Use a "warm" hammer that has previously driven at least one (1) pile, other than the test pile(s), to restrike the test pile(s). The maximum total number of hammer blows for the restrike is 40.

504.3.4.1.4 Procedure for Testing Cast-in-Place Piles

The following are the procedures for testing cast-in-place piles:

1. When the Contractor casts the dynamic test pile(s), the Inspector will make three (3) test cylinders of concrete or grout for each test pile in accordance with AASHTO T 23M.

Provide concrete that will achieve a compressive strength at seven (7) Days of 3,000 psi;

2. After seven (7) Days, weigh the three (3) concrete test cylinders and report the average unit weight to the State Geotechnical Engineer.

Test one (1) concrete cylinder at seven (7) Days. If the compressive strength is at least 3,000 psi, test the other two (2) cylinders. Report the average of the three (3) breaks to the State Geotechnical Engineer.

Perform the dynamic test on the test pile the same Day that the cylinders are broken;

3. If the first test cylinder breaks at less than 3,000 psi, report the result to the State Geotechnical Engineer. The State Geotechnical Engineer may decide either to have the last two (2) cylinders tested the same Day or to wait up to a maximum of 14 additional Days before breaking the last two (2) cylinders. The Day the last two (2) cylinders are tested, re-weigh the cylinders and determine the average unit weight of the concrete.

Perform the dynamic test on the test pile the same Day the last two (2) cylinders are broken.

There will be no added compensation to the Contractor and no time extension to the Contract if Delays occur because the concrete does not achieve the required strength at seven (7) Days;

4. Use the average compressive strength and the average unit weight of the concrete to estimate the modulus of elasticity and the wave speed of the concrete for input into the PDA;
5. Perform excavation around the test pile as needed to mount the gauges. Typically, the required depth of excavation will be twice the diameter of the pile; and
6. Attach the instruments to the pile head and impact the pile with the ram at the free fall height directed by the State Geotechnical Engineer. Each test pile will not require more than 40 blows.

Monitor the pile stresses that result from the ram impact to ensure that the compressive or tensile stresses do not exceed the allowable pile driving stresses defined in Table 501.3.1.4:1, "Wave Equation Analysis Allowable Driving Stress." If

the monitored pile stresses exceed these criteria, the Department will direct the Contractor to reduce the ram free fall height or add pile cushioning.

504.3.4.1.5 Case Pile Wave Analysis

NMDOT Geotechnical Section personnel or approved Pile Dynamic Testing Consultant will perform the Case Pile Wave Analysis as designated on the Plans or determined by the NMDOT State Geotechnical Engineer.

Signal matching analysis (by CAPWAP® software, available from Pile Dynamics, Inc. or equivalent) of the dynamic pile testing data shall be performed on data obtained from the end of initial driving and the beginning of restrike of specified Pile Dynamic Test piles. CAPWAP analysis should be performed by an Engineer who meets the minimum requirements outlined in Section 504.1.1.1, "Dynamic Measurements" and is capable of returning analysis within one (1) Working Day from time of transmission. The State Geotechnical Engineer or Dynamic Testing Consultant may request additional analyses at selected pile penetration depths.

504.3.4.2 Pile Load and Pile Pullout Testing Requirements

504.3.4.2.1 Test Pile and Anchor Pile Requirements

1. **Driven Piles.** The Contractor shall apply the load to a production pile driven in the final Plan location, unless otherwise specified in the Contract, and apply the test frame against anchor (tension) piles;
The Contractor shall use production piles driven in final Plan locations for the anchor piles unless the layout of the test frame reaction points is fixed and inconsistent with the production pile layout or unless an alternative pile type is required to develop adequate pullout resistance. The Project Manager will decide if anchor piles that are not final production piles may be cut-off below final grade or pulled after the testing is completed; and
2. **Cast-in-Place Piles.** The Contractor shall apply the load to a production pile located in the final Plan location, unless otherwise shown in the Contract. The Contractor shall use either driven piles or cast-in-place piles as anchor piles. The Contractor shall not use anchor piles as final production piles. The Contractor shall provide cast-in-place anchor piles with reinforcement capable of carrying the pile tension force.

504.3.4.2.2 Commencement of Load Test

Unless otherwise specified in the Contract, the Contractor shall wait a minimum of 24 h between driving or installing anchor piles or the test pile and commencing with the pile load or pile pullout test.

When testing pipe piles filled with concrete or cast-in-place concrete piles, the Contractor shall begin load tests after the concrete has attained a compressive strength of 2,500 psi.

504.3.4.2.3 Load Testing Procedures

The Contractor shall conduct pile load tests and pile pullout tests in accordance with the following requirements:

1. Perform the *Quick Load Test Method for Individual Piles* in accordance with ASTM D 1143, but take the load test to the first of either failure of the test pile or capacity of the load system;

2. Test pile failure is defined as total vertical pile movement equal to the greater of either five percent (5%) of the pile diameter or two (2) inches;
3. If failure occurs, remove the test load in four (4) approximately equal amounts with a five (5) minute interval between removals;
4. For pile load tests where piles are 24 inch or less in diameter or width, the ultimate capacity is the load that produces a settlement of the pile head in accordance with the following equation:

$$S_f = S + (0.15 + 0.008D) \quad (1)$$

Where,

S_f is the settlement at the ultimate pile capacity in inches

D is the pile diameter or width in inches

S is the elastic deformation of pile length in inches

Use the following equation for piles with diameters or widths greater than 24 inches:

$$S_f = S + \frac{D}{30} \quad (2)$$

Where,

S_f is the settlement at the ultimate pile capacity in inches

D is the pile diameter or width in inches

S is the elastic deformation of pile length in inches

5. For pile pullout tests, the State Geotechnical Engineer will determine when the ultimate pile capacity is attained.

504.3.4.3 Completion of Dynamic Testing of Driven Piles

After completing the dynamic test pile(s) at a Substructure element, the Contractor shall prepare the pile(s) for any specified pile load or pile pullout test(s).

If no load testing is required as determined in Section 501.3.6, "Pile Acceptance" the Final Wave Equation Analysis Acceptance Charts based on results of the Pile Dynamic Testing should be submitted to the Project Manager within thirty six (36) hours after completion of PDA testing and CAPWAP analyses at the applicable Bridge or Structure element.

The Dynamic Testing Consultant shall prepare a written report of the Pile Dynamic Testing results within seven (7) Days of completion of all dynamic test piles specified. This report shall include the results of static load test(s) (if performed) and shall contain a discussion of the pile capacity obtained from the dynamic and static testing. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity.

The Contractor shall drive production piles no deeper than the estimated or minimum penetration elevation before receiving the field Acceptance criteria. The Contractor shall record the average hammer stroke and pile set after driving of each pile to determine pile Acceptance once the driving criteria is established. After receiving the field Acceptance criteria, the Contractor shall drive piles until attaining the required ultimate capacity.

504.3.4.4 Completion of Dynamic Testing of Cast-in-Place Piles

The Contractor shall base the required production pile tip elevation on the dynamic testing and load testing results if specified. The State Geotechnical Engineer will require up to 36 h after completion of the last test pile to provide the pile tip elevation.

Unless the State Geotechnical Engineer directs otherwise, the Contractor shall place no other piles until receiving the production pile tip elevation.

504.3.4.5 Completion of Load Testing

After completing the specified load test(s) to the Project Manager's satisfaction, the Contractor shall dismantle the test apparatus and Equipment and remove from the site. The Contractor shall use the load test results to determine the ultimate pile capacity Acceptance criteria of driven piles as established under Section 501.3.6, "Pile Acceptance," and to confirm ultimate pile capacities determined by dynamic pile tests.

Pulled anchor piles of the same type as the production piles may be reused as production piles if not rejected by the Project Manager due to damage as covered in Section 501.3.6.3, "Damaged Pile Limitations."

For cast-in-place piles, the Contractor shall use the load test results to determine the pile penetration requirements if no subsequent dynamic testing is specified.

The State Geotechnical Engineer will require up to 36 h after completion of the last test pile to provide the pile tip elevation.

The Contractor shall re-drive production piles used as anchor piles in accordance with Section 501.3.6, "Pile Acceptance."

504.4 METHOD OF MEASUREMENT

The Department will measure the actual number of pile tests administered and approved. Pile testing mobilization will be measured as a Lump sum unit.

504.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Pile Testing Mobilization</i>	Lump Sum
<i>Pile Load Test</i>	Each
<i>Pile Pullout Test</i>	Each
<i>Pile Dynamic Test Department Testing</i>	Each
<i>Case Pile Wave Analysis Test Department Testing</i>	Each
<i>Pile Dynamic Test Consultant Testing</i>	Each
<i>Case Pile Wave Analysis Test Consultant Testing</i>	Each

504.5.1 Work Included in Payment

The following Work will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Non-production anchor and test piles which will not remain in use as part of the permanent Structure.

SECTION 505: PILE INTEGRITY TESTING

505.1 DESCRIPTION

505.1.1 General

This Work consists of pile integrity testing for verifying structural integrity and determining the extent and location of cast-in place pile (drilled shaft) defects. Defects may include internal voids, necking of the pile's perimeter, transverse cracks, soil intrusions, weak concrete or grout in drilled shaft foundations.

505.1.2 Test Methods

The Contractor shall use crosshole sonic logging (CSL) performed in accordance with ASTM D6760 (latest edition) or low strain integrity (LSI) performed in accordance with ASTM D5882 (latest edition) testing for integrity testing. The Department may require LSI testing to corroborate the results of CSL testing that show potential defects. Only an approved Integrity Testing Consultant or Department personnel will perform CSL or LSI Testing.

505.1.3 Consultant Integrity Testing

If an Integrity Testing Consultant is required, the consultant's qualifications must meet the requirements of the Geotechnical Design Section and the Equipment used must meet the requirements of ASTM D6760 and Section 505.3.1.1, "CSL Testing Equipment," and ASTM D5882 and Section 505.3.1.2, "LSI Testing Equipment." The Contractor shall perform field testing with an experienced technician or Engineer having at least one (1) year of experience with the integrity testing methods. The Contractor shall use a licensed professional Engineer having at least three (3) years of experience in the integrity testing methods performed to interpret the recorded measurements.

505.1.4 Department Integrity Testing

Department personnel will only perform integrity testing when the Contract specifies CSL or LSI Department testing. Department personnel will use Department-owned Equipment to perform testing.

505.1.5 Assistance

The Contractor shall provide additional labor to perform the testing if required by the testing consultant or Department personnel. The Contractor shall provide access to the piles. If required, the Contractor shall provide a 110 V, 55 Hz to 60 Hz, AC power supply.

505.2 MATERIALS

505.2.1 CSL Access Tubes

The Contractor shall use two (2) inch internal diameter (ID) access tubes of schedule 40 PVC with a round, regular ID free of defects or obstructions to allow passage of the source and receiver probes. The Contractor shall provide watertight tubes with clean internal and external surfaces to ensure a good bond between the concrete and tubes. The Contractor shall fit the tubes with glued caps at the bottom and threaded caps at the top.

505.3 CONSTRUCTION REQUIREMENTS

505.3.1 Equipment

505.3.1.1 CSL Testing Equipment

The Contractor shall use CSL Equipment in accordance with the following requirements:

1. Use ultrasonic source and receiver probes capable of producing records with strong signal amplitude and energy through uniform, high quality concrete. Use probes with a diameter and cabling that will descend freely through two (2) inch ID pipe for the full pile depth;
2. Record probe depth;
3. Use a microprocessor-based CSL measurement system for analog-digital conversion and data recording, individual record display, receiver response analysis, and log printing;
4. Ensure that the CSL system has filter/amplification of data and cables; and
5. Use a CSL system that has a synchronized triggering feature with the ultrasonic pulse for the recording system.

505.3.1.2 LSI Testing Equipment

The Contractor shall use LSI Testing Equipment that meets the following requirements:

1. Use Equipment that has a digital data acquisition system with a dynamic signal analyzer, magnetic disk storage and hardcopy plotting capabilities. Ensure that the analyzer has both signal conditioning and power supply with high signal-to-noise ratios and variable frequency filtering to mitigate steel reinforcing and surface waves vibration noise. Ensure that the data is displayed in the field so that a preliminary data quality evaluation is possible; and
2. Provide a receiver that is a suitable velocity transducer or accelerometer and place on the pile head.

505.3.2 CSL Testing Requirements

505.3.2.1 Preparation of CSL Access Tubes

The Contractor shall place access tubes in drilled shafts where the wet-hole construction method was used, or as directed by the State Geotechnical Engineer. The Contractor shall install access tubes as shown in the Contract. The Contractor shall fasten the tubes to the reinforcement cage, so the tube bottoms are three (3) inches above the shaft bottom and the tube tops are 24 inches above the shaft top. The Contractor shall ensure that the conduit is tied to the reinforcing cage in a plumb and straight position so that the ultrasonic probe may be lowered freely to the bottom of the shaft. Immediately after concrete or grout placement, the Contractor shall fill the tubes with clean water and cap.

505.3.2.2 CSL Testing Procedure

Before construction of the Substructure above the foundation, the Contractor shall direct the CSL consultant to test the completed piles from two (2) Days to ten (10) Days after completing concrete or grout placement. The Contractor shall provide information about the pile's bottom and top elevations, tube lengths and positions, and construction dates to the Integrity Testing Consultant or Department personnel before logging.

The Contractor shall log between each adjacent pair of tubes in the pile. The Contractor shall place the source and receiver probes in the same horizontal plane unless test results indicate potential defects. If potential defects are indicated, the Contractor shall evaluate the

area further using angled tests with the source and receiver vertically offset in the tubes. Additional testing of other untested tube pair combinations may be required.

The Contractor shall simultaneously pull the probes from the tube bottom of the over the depth wheel or other measuring device, once the slack is taken out of the cables, to provide accurate depth measurements. The Contractor shall take the CSL measurements at 2 3/8 inch intervals or less from the bottom to top of the pile. The Contractor shall report defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals to the State Geotechnical Engineer. The State Geotechnical Engineer may require further tests to evaluate the extent of the defects.

The Contractor shall refill CSL tubes with water after testing the shafts containing defects indicated by the initial CSL testing.

505.3.2.3 CSL Testing Results

The Contractor shall report the results of completed CSL testing at a given Substructure element within five (5) Days after testing completion for that element. The Contractor shall provide reports, prepared in accordance with ASTM D6760 (latest edition) to the State Geotechnical Engineer and the Project Manager.

505.3.3 LSI Testing Requirements

505.3.3.1 Pile Head Preparation

The Contractor shall ensure that the pile head is perpendicular to the pile's vertical axis and is made of sound concrete. The Contractor shall remove weak, poor quality, or broken concrete from the pile head to expose sound concrete. The Contractor shall clearly expose the pile head and free it of debris and water. The Contractor shall ground the pile head center impacted by the impulse hammer smooth along with the pile edge area where transducers are attached to provide a flat, horizontal surface for the LSI test.

505.3.3.2 LSI Testing Procedure

The Contractor shall perform LSI testing only when specified or when required by the State Geotechnical Engineer due to potential defects indicated by CSL testing results. The Contractor shall impact the pile head with a hammer that can produce a compression wave capable of being reflected from the pile toe. LSI testing may only be effective to depths of 20 times to 30 times the pile diameter. The Contractor shall take LSI testing measurements in both the time and frequency domains.

The Contractor shall display the motion record (pile top velocity) on a hard copy as a function of time. High soil friction may require velocity signal magnification using integration with exponentially increasing magnitude to enhance the pile toe reflection. The Contractor shall average several consistent records. In addition to the velocity records as a function of time, the amplified and averaged difference between velocity and force may be displayed to provide additional information about the pile top quality, including dynamic stiffness.

The Contractor shall use transient response or impulse response, using hammer force in the frequency domain (mobility) to provide additional defect determination of the pile.

505.3.3.3 LSI Testing Results

1. The Contractor shall report LSI testing results completed at a given Substructure

element within ten (10) Days after completing testing for that element. The Contractor shall provide a report performed in accordance with ASTM D5882 (latest edition) to the State Geotechnical Engineer and the Project Manager.

505.3.4 Acceptance and Rejection of Piles

The Department will Accept piles if pile integrity testing reports verify the structural integrity of the piles. Pile rejection will require conclusive evidence that a defect exists that may result in inadequate or unsafe performance under factored load in LRFD. If the report is inconclusive, the State Geotechnical Engineer may require the Contractor to drill a core hole into the defective pile.

The Department will reject shafts where velocities are less than 10,000 ft per second and the anomalous velocity is less than 25% of the baseline velocity of the CSL record. Such rejection may be due to tubes not being tied in a plumb position and with equal offsets from adjacent tubes.

If a pile is unacceptable, the Contractor shall submit a remedial action plan to the State Geotechnical Engineer. The Contractor shall provide calculations and Working Drawings stamped by a licensed professional Engineer for foundation elements affected by modifications to the foundation piles and load transfer mechanisms caused by the remedial action.

505.4 METHOD OF MEASUREMENT

The Department will measure the actual number of tests administered and approved.

505.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>CSL Consultant Testing</i>	Each
<i>CSL Department Testing</i>	Each
<i>LSI Consultant Testing</i>	Each
<i>LSI Department Testing</i>	Each

505.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and no direct payment will be made therefore:

1. Furnishing all Materials, labor, tools and Equipment necessary to complete the Work;
2. Assistance to the consultant or Department personnel necessary to complete the Work;
3. CSL Access tubes; and
4. Calculations and Working Drawings stamped by a licensed professional Engineer for all foundation elements requiring remedial action, and all labor and Materials necessary to complete corrections for rejected piles. If a defect is confirmed by coring of the concrete, Materials and labor for coring will be at the expense of the Contractor. If no defects are found, the Department will pay for all coring costs, including pressure grouting of the core holes. The time period allowed to perform testing shall be no less than 48 hours to no more than ten (10) Days from time of completion of the construction of the pile.

SECTION 506: MECHANICALLY STABILIZED EARTH RETAINING STRUCTURES

506.1 DESCRIPTION

This Work consists of designing, furnishing all Materials, and constructing mechanically stabilized earth (MSE Panel Walls) retaining Structures in accordance with these Specifications and in compliance with the lines and grades, dimensions and details shown in the Contract.

506.2 MATERIALS

506.2.1 Precast Concrete Elements

The Contractor shall provide precast concrete panel elements conforming to Section 517, "Precast Concrete Structures." The Contractor shall provide Class AA concrete. The concrete mix design shall be prepared in accordance with Section 509, "Portland Cement Concrete Mix Design" and approved by the State Materials Bureau.

506.2.1.1 Casting

For precast concrete face panels, the Contractor shall place the panel forms on a horizontal surface with the front face of the panel at the bottom of the form. The Contractor shall set connection hardware in the rear face. The Contractor shall place the concrete in each precast concrete panel form without interruption and consolidate it with an approved vibrator and hand tamping to force the concrete into the corner of the forms and eliminate the formation of stone pockets or cleavage planes. The Contractor shall use clear form oil throughout the casting operation.

506.2.1.2 Finish

506.2.1.2.1 Non-exposed Surfaces

The Contractor shall screed the rear faces of precast concrete panels to create a uniform surface texture that is free of open pockets of aggregates and surface distortions greater than 3/16 inch. The Contractor shall apply a Class I finish, per Section 511, "Concrete Structures," to other non-exposed surfaces.

506.2.1.2.2 Exposed Surfaces

The Contractor shall provide the type of finish on the exposed surface per the Contract. If the Contract requires an exposed aggregate finish, the Contractor shall produce as follows:

1. Before placing concrete, apply a set retarder to the casting forms in accordance with the manufacturer's instructions;
2. After removing the forms and after the concrete has set sufficiently to prevent dislodging, expose the aggregate with a combination of brushing and washing (using clean water) to a depth of between 3/8 inch and 1/2 inch; and
3. Apply an acrylic resin sealer, consisting of 80% thinner and 20% acrylic solids by weight, to the exposed aggregate surface at a rate of one (1) gal per 250 ft².

506.2.1.3 Tolerances

The Contractor shall manufacture the precast concrete elements in accordance with the following tolerances:

1. Dimensions within precast concrete panels, ± 0.2 inch;
2. Surface defects:
 - 2.1. Smooth formed surfaces not greater than $\pm 3/16$ inch within five (5) feet;
 - 2.2. Textured-finish surfaces not greater than $\pm 5/16$ inch within five (5) feet; and
3. Differences in diagonal lengths not greater than $1/2$ inch.

506.2.1.4 Identification and Markings

The Contractor shall inscribe the manufacture date, the production lot number, and the piece mark on a non-exposed surface of each element.

506.2.1.5 Handling, Storage, and Shipping

The Contractor shall handle, store, and ship units in a manner that prevents damage and discoloration.

506.2.1.6 Compressive Strength

The Contractor shall not ship or place elements in the wall until the design strength is reached. The Contractor shall cast wall panels on a flat area and fully support them until the concrete reaches a minimum compressive strength of 1,500 psi as determined by the Maturity Method detailed in Section 510.3.5.2, "In-Place Concrete Strength Measurements." Unless otherwise specified by the wall manufacturer, the Contractor shall not handle the elements until they reach a compressive strength of 1,500 psi.

506.2.1.7 Rejection

The following defects are sufficient cause for rejection:

1. Connection defects and out-of-tolerance connection imbeds/inserts;
2. Defects indicating imperfect molding;
3. Defects indicating honeycombing or open texture concrete;
4. Cracked or severely chipped panels;
5. Color variation on front face of panel due to excess form oil or other reason; and
6. Presence of oil on panels.

506.2.2 Reinforcing Steel

The Contractor shall provide reinforcing steel in accordance with Section 540, "Steel Reinforcement."

506.2.3 Soil Reinforcement

The Contractor shall provide galvanized steel soil reinforcement. Geosynthetic soil reinforcement will not be allowed. The Contractor shall provide galvanized steel connection hardware in accordance with AASHTO M 111. The Contractor shall support the soil reinforcement while lifting and placing so that the galvanization remains intact and does not crack.

506.2.3.1 Steel Reinforcing Strips

The Contractor shall hot roll reinforcing strips from bars to the required shape and

dimensions. The Contractor shall provide reinforcing strips with physical and mechanical properties in accordance with AASHTO M 223M, Grade 65, or equivalent. The Contractor shall provide shop-fabricated tie strips of hot rolled steel in accordance with ASTM A 1011, Grade 50, or equivalent. The minimum bending radius of the tie strips is one (1) inch. The Contractor shall apply galvanization after strip fabrication.

506.2.3.2 Steel Reinforcing Bar Mats

The Contractor shall provide reinforcing bar mats of cold-drawn steel wire in accordance with AASHTO M 32 and weld the mats into the finished mesh fabric in accordance with AASHTO M 55. The Contractor shall form mesh button heads so that variations between the longest and shortest wire in any mesh is less than one (1) inch. The Contractor shall apply galvanization after mesh fabrication. The Contractor shall provide a one (1) inch coil embed of cold drawn steel wire in accordance with AISI C 1035.

506.2.4 Connector Pins

The Contractor shall provide connector pins and mat bars from A-36 steel and weld to the soil reinforcement mats. The Contractor shall provide connector bars of cold drawn steel wire in accordance with AASHTO M 32.

506.2.5 Precast Concrete Panel Fasteners

The Contractor shall provide fasteners in accordance with the Contract or the approved Working Drawings. The Contractor shall cast fasteners in the precast concrete panels so that the fasteners are in alignment and will result in fasteners transferring a full and even load to the steel grid or steel strap reinforcement. The tolerance between the fastener and the steel reinforcement grid or steel straps for field installation is 3/16 inch. The Contractor shall provide galvanized steel fasteners in accordance with AASHTO M 164.

506.2.6 Precast Concrete Panel Joints

Where walls wrap around a corner, the Contractor shall provide a corner block panel with flange extensions that will allow differential movement without exposing the panel joints. The Contractor shall provide joint filler, bearing pads, and filter fabric in accordance with the wall manufacturer's recommendations and the approved Working Drawings.

If required, the Contractor shall provide flexible foam strips for filler in vertical joints between panels, and in horizontal joints where pads are used, in accordance with the Plans.

The Contractor shall provide the following for horizontal joints between panels:

1. Pre-formed Ethylene Propylene Diene Monomer (EPDM) rubber pads in accordance with ASTM D 2000 for 4AA, 812 rubbers;
2. Neoprene elastomeric pads having a Durometer Hardness (ASTM D 2240) of 55 ± 5; or
3. High-density polyethylene pads with a minimum density of 60 lb per cubic foot in accordance with ASTM D 1505.

The Contractor shall cover the joints between panels on the backside of the wall with a geotextile meeting the requirements for filtration applications in accordance with Section 604.2.4, "Separator Geotextile, Class 3." The Contractor shall provide a minimum lap width of one (1) ft.

506.2.7 Reinforced Fill Material

The Contractor shall provide backfill Material that is free of shale, organic matter, and other soft particles of poor durability. No salvaged Material, such as asphaltic concrete millings, Portland Cement Concrete rubble, etc. will be allowed.

The Contractor shall provide backfill with a soundness loss of 30 or less if tested in accordance with AASHTO T 104 using a magnesium sulfate solution with a test duration of four (4) cycles. The Contractor shall determine gradations in accordance with AASHTO T 27 and Table 506.2.7:1, "Backfill Gradation Requirements," unless otherwise specified.

**Table 506.2.7:1
Backfill Gradation Requirements**

Sieve size	% passing
Four (4) inch	100
No. 40	0–60
No. 200	0–15

The Contractor shall provide backfill with a PI, no greater than six (6) in accordance with AASHTO T 90.

The Department defines "rock backfill" as the Material that is composed primarily of rock fragments (Material having less than 15% passing a 1/2 inch sieve and no more than five percent (5%) passing a No. 4 sieve). If using "rock backfill," the Contractor shall place a separator geotextile over the top of the backfill Material before placing the top two (2) ft of backfill. Also, the Contractor shall place a separator geotextile between the rock backfill and the random fill as the reinforced soil backfill is placed. The Contractor shall provide a separator geotextile in accordance with the minimum requirements for filtration applications in AASHTO M 288 and Section 604, "Soil and Drainage Geotextiles." The Contractor shall ensure the upper two (2) ft of backfill does not contain stones larger than three (3) inches at their greatest dimension and is free of rock backfill.

506.2.7.1 Internal Friction Angle Requirement

The Contractor shall provide backfill that exhibits a minimum angle of internal friction of at least 34° in accordance with AASHTO T 236 unless otherwise specified in the Contract. The Contractor shall perform the test on backfill Material passing the No. 10 sieve. The Contractor shall compact the sample in accordance with Section 506.3.5.1, "Compaction," at optimum moisture content, to 95% of maximum density. The Department will not require direct shear testing for backfills when the gradation is less than 20% passing a 3/4 inch sieve.

The Contractor shall submit a Materials test report to the Project Manager, prepared by an independent Laboratory accredited through the AASHTO Materials Reference Laboratory (AMRL), or other Department approved accreditation program, indicating that the internal friction angle of soil meets or exceeds the requirements specified in the Contract. The Contractor shall prepare the test report in accordance with applicable AASHTO Test Standards.

506.2.7.2 Electrochemical Requirements

The Contractor shall provide backfill in accordance with Table 506.2.7.2:1, "Electrochemical Requirements for Steel Reinforcement," when using steel soil reinforcement.

**Table 506.2.7.2:1
Electrochemical Requirements for Steel Reinforcement**

Characteristic	Requirement	Test method
pH	5-10	AASHTO T 289
Resistivity	>2,500 ohm/cm	AASHTO T 288
Chlorides	<100 ppm	AASHTO T 291
Sulfates	<200 ppm	AASHTO T 290
Organic content	<one percent (1%)	AASHTO T 267

The Department will not require electrochemical testing for backfills when the gradation is less than 20% passing a 3/4 inch sieve and less than five percent (5%) passing the No. 200 sieve. No salvaged Material, such as asphaltic concrete millings, Portland Cement Concrete rubble, etc. will be allowed.

The Contractor shall submit a Materials test report to the Project Manager, prepared by an independent Laboratory accredited through the AASHTO Materials Reference Laboratory (AMRL), or other Department approved accreditation program, indicating that the soil Material meets the requirements specified in the Contract. The Contractor shall prepare the test reports in accordance with the applicable AASHTO Test Standards referenced in the table above.

506.2.8 Cast-in-Place Concrete

The Contractor shall provide cast-in-place concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs," Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures." Unless otherwise approved, the Contractor shall use Class A concrete for cast-in-place concrete.

506.2.9 Reserved

506.2.10 Submittals

The Contractor shall ensure a New Mexico registered Engineer signs and seals Working Drawings and Design Calculations.

506.2.10.1 Working Drawings

The Contractor shall submit Working Drawings to the Project Manager, for review and approval by the State Bridge Engineer at least 40 Days before beginning Work on MSE retaining Structures. The Contractor shall submit three (3) complete sets of half-size prints for preliminary review. The State Bridge Engineer will return one (1) set of prints to the Contractor with notations. The Contractor shall make necessary corrections and submit eight (8) sets of prints for final review, approval and distribution. The Contractor shall not begin fabrication or erection before receiving written notification that the drawings are approved. Working Drawings shall include the following:

1. Layout of the wall including Plan and elevation views;
2. Existing ground elevations field verified by the Contractor for each location that will involve wall construction wholly, or in part, on natural ground;
3. Complete details of elements and component parts required for the proper construction of the system;
4. A complete listing of Materials Specifications;
5. Earthwork requirements, including Specifications for Material and compaction; and
6. Other information required by the Contract or requested by the State Bridge

Engineer.

Approval of the final Working Drawings covers the requirements for strength and detail, and the Department assumes no responsibility for errors or omissions in the Working Drawings. The Contractor shall provide three (3) sets of the manufacturer's written erection instructions with the final Working Drawings submittal.

506.2.10.2 Design Calculations

Along with the Working Drawing submittals, the Contractor shall submit complete design calculations, including those required to establish service life, to the Project Manager for approval by the State Geotechnical Engineer for approval. The Contractor shall ensure the calculations confirm that the proposed design satisfies the design parameters in accordance with the Contract and the following:

1. FHWA NHI-10-024 Vol I and NHI-10-025 Vol II, "Design of MSE Walls and Reinforced Slopes," (Berg et al., 2009); and
2. Current "AASHTO LRFD Bridge Design Specifications," (and interims).

The Contractor shall provide Structures meeting the requirements of Table 506.2.10.2:1, "Design Parameters", unless otherwise specified in the Contract.

**Table 506.2.10.2:1
Design Parameters**

Description	Limit State	Value
<u>Resistance Factor</u>	<u>Limit State</u>	
Sliding	Strength (all)	
^b Bearing	Strength (all)	
^b Deep Seated Stability	Service I	
^b Compound Stability	Service I	
Pullout resistance		Current AASHTO LRFD Bridge Design Specifications Section 11
Static	Strength (all)	
Combined static/earthquake	Strength (all)	
Tensile resistance of metallic reinforcements and connectors		
Static		
Strip and Grid reinforcement	Strength (all)	
Combined static/earthquake		
Strip and Grid reinforcement	Strength (all)	
Service life		75 years
Service life (supporting Structure loads)		100 years
Soil unit weight (retained)		120 lb/ft ³
Soil unit weight (reinforced)		125 lb/ft ³
Friction angle (retained soil)		30°
Friction angle (reinforced soil)		34°
Coefficient of sliding friction		^a

**Table 506.2.10.2:1
Design Parameters**

Description	Value
Allowable bearing pressure	a
Minimum soil reinforcement embedment depth	a

^aIn accordance with the Contract.
^bGlobal Stability is responsibility of NMDOT

506.2.10.3 Certificates of Compliance

The Contractor shall provide the Project Manager with a Certificate of Compliance for the Material (excluding concrete) that certifies that the Material is in accordance with the Contract and the approved Working Drawings.

506.2.10.4 Reinforced Fill Material Test Reports

The Contractor shall submit a complete Materials test report to the Project Manager, prepared by an independent Laboratory accredited through the AASHTO Materials Reference Laboratory (AMRL), or other Department approved accreditation program, indicating that the soil and/or rock Material meets the requirements specified in the Contract. The Contractor shall prepare the gradation, friction angle (direct shear), and electrochemical test reports in accordance with the applicable AASHTO or ASTM Test Standards.

506.2.10.5 Exposed Surface Finish Panel Sample

If the Contract requires an exposed aggregate or other architectural finish, the Contractor shall deliver a 36 inch × 36 inch panel, finished as specified, to the Project Manager for approval by the Landscape Architect.

506.3 CONSTRUCTION REQUIREMENTS

506.3.1 Excavation

The Contractor shall perform wall construction excavation as unclassified excavation in accordance with Section 203, "Excavation, Borrow, and Embankment."

506.3.2 Foundation Preparation

The Contractor shall Grade the foundation for the structural volume level for the entire area of the base of the Structure plus 12 inches on all sides, or as shown in the Contract. Before wall construction, the Contractor shall break up the original ground surface to at least six (6) inches by plowing or scarifying. The Contractor shall compact this area to 95% of maximum density in accordance with Section 203.3.6, "Moisture and Density Control."

The Contractor shall remove unsuitable foundation Material, replace with suitable Material meeting the requirements of Section 506.2.7, "Reinforced Fill Material," and compact in accordance with this Specification unless otherwise approved by the State Geotechnical Engineer.

506.3.3 Concrete Leveling Pad

The Contractor shall provide a leveling pad in accordance with the approved Working Drawings. The Contractor shall cure the pads at least 12 hours before placement of wall panels.

506.3.4 Wall Erection

The Contractor shall erect walls in accordance with the manufacturer's written instructions. The Contractor shall ensure that a field representative from the manufacturer is available during the erection of the first ten percent (10%) of the wall (and as directed by the Project Manager) to assist the Fabricator, Contractor, and Project Manager. The Contractor shall place panels so that their final position is vertical or battered in accordance with the Contract. The Contractor shall sequence the placement of panels in successive horizontal lifts during backfill placement in accordance with the Working Drawings.

506.3.4.1 Placement Tolerances for Precast Elements

When placing backfill Material, the Contractor shall maintain precast elements in the specified vertical alignment with temporary wedges or bracing as recommended by the manufacturer. The Contractor shall ensure that vertical and horizontal alignment tolerances do not exceed 0.75 inch if measured with a ten (10) foot straightedge. The Contractor shall ensure that the overall horizontal tolerance (plumbness) of the vertical wall does not exceed 0.5 inch per ten (10) feet. The Contractor shall ensure that the offset at any panel joint does not exceed 0.4 inch.

506.3.4.2 Placement of Reinforcement Elements

The Contractor shall install the reinforcement elements normal to the face of the wall, unless otherwise shown on the Plans. The Contractor shall ensure that the reinforcement bears uniformly on the compacted reinforced soil from the connection to the wall to the end of the reinforcing elements. The Contractor shall not cut the reinforcement elements to accommodate obstructions within the reinforced soil zone. The Contractor shall not weld soil reinforcements (shop or field welds) to extend lengths of longitudinal reinforcements. The Department will allow approved shop welds at the connections and approved spot-welds at the transverse and longitudinal intersections of bar mats.

506.3.5 Backfill Placement

The Contractor shall perform backfill placement immediately after erecting each level of wall panels. The Contractor shall place backfill carefully to avoid damage or disturbance of the wall Materials, misalignment of wall panels, or damage to soil reinforcement. The Contractor shall replace wall Materials damaged during backfill placement at no additional cost to the Department. If backfill placement causes misalignment or distortion of wall panels, the Contractor shall correct at no additional cost to the Department.

506.3.5.1 Compaction

The Contractor shall compact backfill in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), Note 7, to 95% of the maximum density, except as modified in accordance with Section 506.3.5.1.2, "Compaction Against Faces of Walls."

506.3.5.2 Compaction Against Faces of Walls

The Contractor shall compact the backfill to 90% density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), within three (3) ft of the wall. The Contractor shall compact with a minimal number of passes using a lightweight mechanical tamper, roller, or vibratory system. The Contractor shall determine the number of passes with a test section before compaction against the wall, as approved by the Project Manager. The Contractor shall use approved compaction Equipment from the test section for production

Work. If changing Equipment, the Contractor shall create a new test section to determine the number of passes for the Project Manager's approval.

506.3.5.3 Moisture Control

The Contractor shall uniformly distribute the moisture content of the backfill Material throughout each layer before and during compaction. The Contractor shall ensure that backfill Materials have an in-place moisture content of three percent (3%) less than optimum to optimum. The Contractor shall remove backfill Material with in-place moisture content greater than optimum and rework, or replace with Acceptable backfill Material.

506.3.5.4 Lift Thickness

The Contractor shall ensure that the maximum lift thickness after compaction does not exceed eight (8) inches. The Contractor shall decrease the lift thickness, if necessary, to obtain the specified density.

506.3.5.5 Protection of the Work

At the end of each Day's operation, the Contractor shall slope the last level of backfill away from the wall to direct runoff away from the Structure. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

506.4 METHOD OF MEASUREMENT

The Department will measure the face of MSE Panel Walls based on the dimensions shown in the Contract or approved modifications.

The Department will measure authorized *Excavation of Unsuitable Foundation Material* from the foundation surface to the depth of excavation in its original location. The Department will not measure Material excavated outside the area bounded by vertical planes two (2) feet beyond the limits of the Material designated for removal.

506.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>MSE Panel Wall</i>	<i>Square Foot</i>
<i>Excavation of Unsuitable Foundation Material</i>	<i>Cubic Yard</i>

506.5.1 Work Included In Payment

The Department will consider the following Work as included in the payment for the pay item(s) and will not measure or pay separately for the following:

1. Excavation for MSE retaining Structures including any required temporary shoring;
2. Temporary shoring required for excavation of unsuitable foundation Material;
3. Placement and compaction of backfill Material within the reinforced soil zone, backfill within the limits of unsuitable foundation Material excavation, and/or other areas identified in the Contract;
4. Dewatering for excavation of MSE Retaining Structures and/or dewatering for authorized excavation of unsuitable foundation Materials;
5. Leveling pads, facing elements, reinforcing bars, soil reinforcements, attachment devices, backfill, coping, drainage elements, foundation preparation, and geotextile

fabric;

6. Providing the manufacturer's field representative; and
7. Survey, calculations, engineering, and reporting.

SECTION 509: PORTLAND CEMENT CONCRETE MIX DESIGNS

509.1 DESCRIPTION

This Work consists of developing, submitting and receiving approval to use Portland Cement Concrete (PCC) mix designs for use on Department Projects.

For the purposes of this Section, the following definitions are used:

1. Supplier: Any individual, partnership, company, firm, corporation, or joint venture that owns the Approved Concrete Mix Design, for concrete that is incorporated into a Department construction Project(s).
2. The terms "mix" and "mixture" are used interchangeably.

509.2 MATERIALS

All Materials shall be in accordance with AASHTO and ASTM methods or other test procedures designated by the Department. The State Materials Bureau is the final authority regarding the interpretation of test procedures.

The certifying laboratory or Private Testing Laboratory (PTL) performing the physical and chemical tests for the Supplier is required to participate in the Cement and Concrete Reference Laboratory (CCRL) proficiency sample and the pozzolan inspection programs.

509.2.1 Reserved

509.2.2 Cementitious Materials

Unless otherwise specified, the Supplier shall use; (1) a combination of Type II, III, or V Portland cement and supplemental cementitious Materials (SCM), (2) Blended cement, or (3) a combination of blended cement and SCM. Supplemental cementitious Materials used in blended cements shall not be used as a replacement of portland cement for mix design purposes.

509.2.2.1 Portland and Blended Cements

Portland cement shall comply with ASTM C150. Types II, III, and V portland cement shall have an alkali content less than 0.60% by mass of alkalis as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ when determined under AASHTO T 105. Types III and V portland cements shall only be used if specified or authorized by the State Concrete Engineer.

Blended cements shall comply with Type IS (S) – portland blast-furnace slag cement, Type IP (MS) – portland-pozzolan cement, or Type IT – Ternary blended cement as specified in ASTM C595, except:

1. Portland cement used in blended cements shall comply with the requirements listed in 509.2.2.1;
2. Class C fly ash shall not be used in blended cements, unless otherwise approved by the State Concrete Engineer;
3. SCM used in blended cements shall meet the requirements of Section 509.2.2.2, "Supplementary Cementitious Materials;"
4. Maximum SCM content shall not exceed 50%; and
5. Blended cement shall be composed of Type II or V portland cement and SCM produced by one of the following methods:

- 5.1. Intergrinding of portland cement clinker and SCM;
- 5.2. Blending of portland cement and SCM; and
- 5.3. Combination of intergrinding and blending of portland cement and SCM.

509.2.2.2 Supplementary Cementitious Materials

Each SCM shall be in accordance with the following standards and as modified in Table 509.2.2.2:1, "Supplementary Cementitious Material Requirements:"

1. Portland cement used in blended cements shall comply with the requirements listed in Section 509.2.2.1, "Portland and Blended Cements;"
2. Class C and F fly ashes shall comply with the requirements of ASTM C618:
 - 2.1. Class C fly ash shall not be used in concrete exposed to sulfate environments or with "potentially reactive," or "reactive" aggregate;
3. Ultrafine fly ash (UFFA) shall comply with ASTM C618, Class F;
4. Natural or calcined natural pozzolans shall comply with ASTM C618, Class N;
5. Metakaolin shall comply with ASTM C618, Class N;
6. Ground granulated blast furnace slag (GGBFS) shall comply with ASTM C989, Grade 100 or 120; and
7. Silica fume shall comply with ASTM C1240.

**Table 509.2.2:1
Supplementary Cementitious Material Requirements**

SCM Type	Material Standard	Properties	Limits		
			N	F	C
Coal Fly Ash, and Raw or Calcined Natural Pozzolans	ASTM C618	Class	N	F	C
		Sum of Al ₂ O ₃ , SiO ₂ , and Fe ₂ O ₄ , min	75%	85%	50%
		Loss on ignition, max	5.0%	3.0%	3.0%
		Magnesium Oxide (MgO), max	5.0%	5.0%	5.0%
		Sulfur Trioxide (SO ₃), max	3.0%	3.0%	3.0%
		Available alkalis as Na ₂ O + 0.658 K ₂ O, max	1.50%	1.50%	1.50%
		Calcium Oxide (CaO), max	As Approved	8.0%	50%

**Table 509.2.2.2:1
Supplementary Cementitious Material Requirements**

SCM Type	Material Standard	Properties	Limits
Ultra Fine Fly Ash in addition to the requirements for Class F fly ash	AASHTO M 321	Accelerated Pozzolonic Activity Index,	
		<ul style="list-style-type: none"> • 7 day 85% • 28 day 100% 	
		Particle size distribution	
		<ul style="list-style-type: none"> • less than 2.25 μm 50% • less than 8.50 μm 90% 	
		Fineness, retained on 45 μm wet sieve, max	5.0%
		Moisture content, max	1.0%
Metakaolin	ASTM C618	Silicon dioxide (SiO ₂) + aluminum oxide (Al ₂ O ₃), min	92%
		Calcium oxide (CaO), max	1.0%
		Sulfur trioxide (SO ₃) max	1.0%
		Loss on ignition, max	1.2%
		Available alkalis as Na ₂ O + 0.658 K ₂ O, max)	1.5%
		Accelerated Pozzolonic Activity	

**Table 509.2.2.2:1
Supplementary Cementitious Material Requirements**

SCM Type	Material Standard	Properties	Limits
		Index, <ul style="list-style-type: none"> • 7 day • 28 day Fineness, retained on 45 μ m wet sieve, max	85% 95% 5.0%
Silica Fume	ASTM 1240	Reduction in mortar bar expansion when used with cement in the proposed mix design, min	80%

509.2.2.3 Cementitious Materials Source Approval and Acceptance

The Department will approve individual cementitious Materials based upon compliance with the respective ASTM or AASHTO Standard Specifications and the requirements listed in this Section. The following information shall be included with each cementitious Material approval request submittal:

1. Supplier name and address;
2. Manufacturer name and address;
3. Production facility physical address;
4. Material type;
5. Material source/origin;
6. Raw Material source(s);
7. Production procedures;
8. Description of storage facilities;
9. Quality Control program documentation including the following:
 - 9.1. Certifying Laboratory's accreditation and current participation in the ASTM Cement and Concrete Reference Laboratory Program (CCRL);
 - 9.2. Routine sampling and testing frequency; and
 - 9.3. QC program test reports (mill certs) for each lot tested from the previous six (6) months shall be provided upon request from the Department;
10. Cementitious Materials shall be tested and certified for conformance with the respective Material Specifications below:
 - 10.1. Portland cements: ASTM C150 – Standard Specification for Portland Cement; and

- 10.2. Blended cements: ASTM C595 – Standard Specification for Blended Hydraulic Cements;
 - 10.2.1. Portland cements used in manufacturing blended cements: ASTM C150 – Standard Specification for Portland Cement; and
 - 10.2.2. SCM used in manufacturing blended cements: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; and
- 11. Supplementary Cementitious Materials shall be tested and certified monthly for conformance with the respective Material Specifications listed below:
 - 11.1. Pozzolans: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete;
 - 11.2. Metakaolins: ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete;
 - 11.3. GGBFS: ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars; and
 - 11.4. Silica fume: ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

509.2.2.4 Withdrawal of Source Approval

The State Materials Bureau may withdraw cementitious Material source approval for any of the following reasons:

- 1. A change in Material source or production procedure from that on the original request for approval;
- 2. Failure to comply with Specification requirements;
- 3. The source becomes inactive for a period of three (3) months; or
- 4. The appropriate cementitious Material mill certificates are not received monthly.

509.2.2.5 Packaging

Cementitious Materials shall be packaged with the name brand, the source manufacturing facility, Material type, date of production and lot number. The Supplier shall provide the same information, as well as quantities, on the shipping documents for bulk cementitious Materials deliveries.

509.2.2.6 Storage

Different brands of SCM or cements from different production facilities shall be stored in separate, identifiable storage units provided at the production facilities. Each cementitious Material shall be stored separately.

509.2.3 Aggregates

509.2.3.1 Aggregates Testing

Coarse and fine aggregate shall be tested in accordance with the methods shown in Table 509.2.3.1:1, "Aggregates Test Methods." Concrete mix design approval involving a designated source will remain in effect as long as annual test results for specific gravity, absorption, gradation, and sand equivalent (for fine aggregate only) and annual tests for other requirements (except ASR) demonstrate Material compliance.

**Table 509.2.3.1:1
Aggregates Test Methods**

Method	Aggregate test	Coarse	
		Aggregates	Fine Aggregates
AASHTO T 2	Sampling	Note ^A	Note ^A
AASHTO T 112	Clay lumps, max	2.5%	3.0%
	Soft fragments, max	2.0%	2.0%
	Coal & lignite, max	0.25%	1.0%
AASHTO T 27	Sieve analysis	Note ^B	Note ^{C, D}
AASHTO T 11	Passing No. 200, max	2.0% ^E	3.0% ^E
AASHTO M 6	Fineness modulus	NA	2.3 to 3.1 ^F
AASHTO T 85	Coarse aggregate absorption & specific gravity	Report	NA
AASHTO T 84	Absorption & Specific Gravity of Fine Aggregate	NA	Report
AASHTO T 104	Magnesium sulfate soundness, max	15%	12%
ASTM C131	L.A. Abrasion	40%	NA
ASTM D3744	Aggregate Index, min	25	NA
ASTM D4791 TTCP Modified	Flat and elongated pieces, max	15% ^G	NA
ASTM D5821	Fractured faces, min	Report	NA
AASHTO T 176	Sand equivalent, min	NA	75
ASTM C295	Petrographic analysis	Report	Report
AASHTO T303 or ASTM C1293	Alkali-Silica Reactivity	Report	Report

Notes:

1. Coarse and fine aggregates shall be sampled in accordance with AASTO T 2.
2. See Table 509.2.3.2.3:1 – Coarse Aggregate Gradation Requirements.
3. See Table 509.2.3.3.3:1 – Fine Aggregate Gradation Requirements.
4. The Department will not approve fine aggregate that has more than 45% passing any sieve and retained on the next finer sieve.
5. The Department may Accept coarse and fine aggregates with more than the maximum percent passing the No. 200 sieve if the combined gradation of the coarse and fine aggregate percent passing the No. 200 sieve does not exceed three percent (3.0%).
6. Ensure that Material larger than 3/8 inch contains no more than 15% flat or elongated particles with a 3:1 or greater dimensional ratio in accordance with TTCP. Add the percentage of flat pieces to the percentage of elongated pieces to determine specification compliance. Count pieces that are both flat and elongated only once.

509.2.3.2 Coarse Aggregate

Coarse aggregate shall consist of clean crushed stone, crushed gravel, or natural washed gravel free of trash, debris, organics, and other Deleterious Materials.

509.2.3.2.1 Coarse Aggregate Gradation Requirements

When using the combined gradation procedure in Section 509.2.7.5.1, “Combined Gradation;” coarse aggregate gradation requirements are not required with the exception of tolerance for Material passing the No. 200 sieve found in Table 509.2.3.2.1:1, “Coarse Aggregate Gradation Requirements.” Coarse aggregate gradations shall be in accordance with Table 509.2.3.2.1:1, “Coarse Aggregate Gradation Requirements.”

**Table 509.2.3.2.1:1
Coarse Aggregate Gradation Requirements**

Sieve size	% of aggregate passing sieve			
	1.5 in	1.0 in	3/4 in ^A	1/2 in
2.0 inch	100	—	—	—
1.5 inch	95–100	100	—	—
1.0 inch	—	95–100	100	—
3/4 inch	35–70	—	90–100	100
1/2 inch	—	25–60	—	90–100
3/8 inch	10–30	—	20–55	40–70
No. 4	0–5	0–10	0–10	0–15
No. 8	—	0–5	0–5	0–5
No. 200	0.0–2.0	0.0–2.0	0.0–2.0	0.0–2.0

A. Required for Class G gradation.

509.2.3.3 Fine Aggregate

Fine aggregate shall consist of clean and well-graded natural sand, manufactured sand, or combination of both, and free of trash, debris, organics, and other Deleterious Materials.

509.2.3.3.1 Fine Aggregate

When using the combined gradation procedure detailed in Section 509.2.7.5.1, “Combined Gradation;” fine aggregate gradation requirements are not required except for the amount of Material passing the No. 200 sieve which shall be within the tolerance listed within Table 509.2.3.3.1:1, “Fine Aggregate Gradation Requirements.”

Fine aggregate shall meet the gradation requirements listed in Table 509.2.3.3.1:1, “Fine Aggregate Gradation Requirements.” The gradation requirements represent the limits that the Department will use to determine source Acceptability.

The Supplier shall use a fineness modulus, calculated in accordance with AASHTO M 6, to determine the degree of uniformity between representative samples. If the combined gradation procedure has not been chosen, the Department may reject fine aggregate from designated sources with variation in fineness modulus greater than 0.20 above or below the fineness modulus shown on the approved concrete mix designs. Variations in excess of these tolerances may be cause for rejection.

**Table 509.2.3.3.1:1
Fine Aggregate Gradation Requirements**

Sieve size	% Passing
3/8 inch	100
No. 4	90–100
No. 8	70–95
No. 16	45–80
No. 30	25–60
No. 50	5–30
No. 100	0–8
No. 200	0.0–3.0

509.2.3.4 Aggregate Alkali-Silica Reactivity

The Supplier shall perform the initial proof-of-reactivity-potential test using standard GCC Type I-II low alkali cement from the GCC Cement plant located at Tijeras, New Mexico. The Department considers aggregates with mean mortar bar expansions of greater than 0.10% at 14 Days when tested in accordance with AASHTO T 303 or ASTM C1260 potentially reactive and those less than 0.10% as non-reactive. Expansions greater than 0.20% are considered "Reactive." If tested using ASTM C1293, the Department will consider aggregate non-reactive if the average expansion at the end of one (1) year is less than 0.04%. Once the State Materials Bureau approved a particular aggregate source is non-reactive, it will not require the source to reevaluate for five (5) years unless concerns arise from possible aggregate source changes.

509.2.3.4.1 ASR Mitigation Evaluation Criteria

If the results of the initial proof-of-potential-reactivity test show the aggregate to be "potentially reactive" or "reactive," the Contractor shall repeat the test procedure using the actual cement, and, if desired, any of the ASR inhibiting SCM and admixtures listed in Table 509.2.3.4.1:1, "Option 2 Mix Designs - ASR Mitigation Requirements." The Department will consider an admixture effective if the mean mortar bar expansion at 14 Days is less than or equal to 0.10%, when tested in accordance with AASHTO T 303 (modified to include SCM) or ASTM C1567. The Supplier shall retest aggregates classified as "potential reactive" or "reactive" for ASR mitigation each time the comprehensive mix evaluation is performed. The Contractor shall report the minimum amount of Class F fly ash, and the minimum amount of ASR inhibiting admixture required to provide a maximum expansion at 14 Days that is less than 0.10%. The SCM required for mitigation shall be reported as a percentage of the cement weight. For Option 2 mix designs, the Contractor shall use ASR inhibiting SCMs or admixtures in accordance with Table 509.2.3.4:1, "Option 2 Mix Designs - ASR Mitigation Requirements," unless it is determined that larger dosages are required to control the expansion.

**Table 509.2.3.4:1
Option 2 Mix Designs - ASR Mitigation Requirements**

SCM	Minimum SCM Content^{A, B}
Class F	
Binary Blends	20%
Ternary Blends ^C	12%
Blended cement	20%
GGBFS	20%
Silica fume	10%
Lithium nitrate	0.55 gal/yd ³ of solution for each pound of cement sodium equivalent

Table 509.2.3.4:1
Option 2 Mix Designs - ASR Mitigation Requirements

Notes:

1. By total cementitious content.
 2. Or minimum amount required to mitigate ASR expansion, whichever is greater.
 3. 20% combined SCM content or minimum amount required to mitigate ASR expansion, whichever is greater.
-

509.2.4 Admixtures

Admixtures types and brands are required to be on the Department's APL at the time of mix design submission. Air entraining, and chemical, and lithium nitrate admixtures shall not contain more than 0.1% of soluble and insoluble chlorides. Individual admixtures shall be compatible with each other when multiple admixtures are used in a concrete mixture. Admixtures shall be used in compliance with the manufacturer's written instructions.

509.2.4.1 Air Entraining Admixtures

Air-entraining admixtures shall be provided in accordance with ASTM C260.

509.2.4.2 Chemical Admixtures

Any of the following chemical admixtures types as defined by and meeting the requirements of ASTM C494 may be used to facilitate concrete mix design:

1. Type A – Water Reducing;
2. Type B – Retarding;
3. Type D – Water Reducing and Retarding;
4. Type F – Water Reducing, High Range; or
5. Type G – Water Reducing, High Range, and Retarding.

The following admixtures may be used if approved by the State Concrete Engineer:

1. Type C – Accelerating;
2. Type E – Water Reducing and Accelerating; or
3. Type S – Specific Performance.

Any of the following chemical admixtures types as defined by and meeting the requirements of ASTM C1017 may be used to facilitate concrete mix design:

1. Type 1 – Plasticizing; or
2. Type 2 – Plasticizing and Retarding.

509.2.4.3 Lithium Nitrate Chemical Admixture

Lithium nitrate shall be in an aqueous solution meeting the following:

1. Lithium nitrate as LiNO_3 shall be 30% by weight;
2. Sulfate as SO_4 shall be less than 0.1% (1,000 PPM); and
3. Alkalis as $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ shall be less than 0.1%.

509.2.4.4 Pigment Admixtures for Integrally Colored Concrete

Pigments shall conform to ASTM C979. Pigments shall be lightfast, alkali-resistant, weather resistant, and formulated to give long lasting color to concrete.

509.2.5 Water

Water shall conform to ASTM C1602. Water shall have a pH between 6.0 and 8.5; sulfate or chloride contents shall not exceed 1,000 ppm, and shall be free of oil, silt, clay, organic matter, or other Deleterious Material.

509.2.6 Fiber Reinforcement

If specified, steel fibers shall conform to ASTM A820, and synthetic fibers conform to ASTM C1116.

509.2.7 Portland Cement Concrete Mix Design

Concrete mixtures shall be designed in a PTL approved by the Department, by a Professional Engineer registered in the State of New Mexico with a minimum of three (3) year of experience in testing, proportioning and designing of concrete and is directly responsible for all test results used for design purposes. The laboratory mix design shall only be developed using the proposed Materials.

Only technicians who are currently certified by TTCP - Concrete or ACI Concrete Field Technician, Level I shall determine concrete fresh properties in accordance with the appropriate AASHTO procedures. Laboratories approved by the Department's State Materials Bureau shall determine hardened properties. Technicians performing tests on aggregates and aggregate gradations shall be certified by TTCP or ACI Concrete Laboratory Level I. Those technicians performing strength tests on hardened concrete must be certified as an ACI Level I Laboratory Technician or by TTCP for Compressive Strength Testing of Concrete.

509.2.7.1 Concrete Classifications

The concrete classes listed below shall be used when specified in the Contract:

1. Class A: Structural, cast-in-place sidewalks, curb/gutter, concrete wall barrier, Bridge Substructures;
2. Class AA: Structural, used for cast-in-place structural, Bridge Superstructure, approach slabs, abutments;
3. Class HPD: Structural, used for Bridge decks, concrete paving, concrete paving repair. Additional requirements: combined gradation protocol, shrinkage ASTM C157 less than 0.04% at 28 days;
4. Class F: Slip formed concrete wall barrier, curb/gutter; compressive strength measured at 14 days;
5. Class G: Below grade applications, caissons, drilled piers (part of Bridge Substructure);
6. Class HES (formerly rapid set): High early strength concrete used for rapid repair applications. Early compressive strengths will be determined on a per Project basis. Cement content will be determined by lab trials. Allowable cements: Type II, III and rapid strength cements;
7. Class P (formerly class F-LS): Concrete paving. Mix design shall include compressive strengths in addition to flexural beams in order to develop a correlation curve. Other additional requirements: combined gradation protocol, shrinkage

ASTM C157 less than 0.04% at 28 days; and

8. Special: The Contract Requirements for the individual Project will address mix design and testing requirements.

509.2.7.2 Concrete Class Requirements

Option 1 or Option 2 may be used for mix design development of the Concrete Classes listed in Table 509.2.7.2:1, "Option 1: Concrete Requirements." Mix designs developed using Option 1 shall be approved by the State Concrete Engineer for estimated Project quantities less than those provided in the table below. The Department may consider requests to increase the maximum estimated quantity on a Project specific basis. Mix designs developed using Option 1 do not require ASTM C666 testing, and ASTM C457 hardened air void characteristics.

For Projects with anticipated concrete quantities of 150 CY or less of an individual concrete class, a written request may be submitted to the State Concrete Engineer to issue the a mix design under Section 509.2.7.6.12, "Mixture Design Submittals," bullet 13.3, "Incidental Concrete."

**Table 509.2.7.2:1
Option 1: Concrete Requirements**

Class	Strength ^A , psi	W:CM Ratio, max	Minimum Cementitious Content, lbs/CY	Maximum Estimated Project, Quantity	Slump ^B , Inches	Air Content ^C , %
A	3,000	0.45	560	1,000 CY	3 - 5"	-
F	3,000 ^D	0.45	575		0.5 - 2"	-
G	3,000	0.44	611		6 - 9"	< 3% ^G
HES	4,000 ^F	0.40	NA	500 CY	Note H	-
P	3,000 ^D and 650 ^E flex	0.35	600	10,000 SY	0.5 - 2"	-
Special	The Contract Requirements for the individual Project will address special mix requirements.					
Notes:						
<ol style="list-style-type: none"> 1. Specified strength shall be achieved by 28 days unless otherwise noted. 2. As determined by AASHTO T 119. 3. Project risk zone requirements apply; see Section 509.2.7.4, "Freeze-Thaw Risk Zones." 4. Specified strength shall be achieved by 14 days. 5. Specified flexural strength shall be achieved by 28 days. 6. Specified strength shall be achieved in 24 hours, and 75% of the specified strength shall be achieved in five (5) hours, unless otherwise stated in the Contract. 7. Air entraining admixtures are not allowed. 8. Mix design specific for Project specific requirements. 						

For Option 1 mix design development, the minimum SCM in concrete shall comply with one of the following:

1. Any combination of cement and a minimum of one (1) SCM satisfying Equation 1:

Equation 1:

$$\frac{(25 \times UF) + (12 \times FA) + (6 \times SL)}{MC} \geq X$$

Where:

UF = silica fume, metakaolin, or UFFA, including the quantity in blended cement, lb/CY.

FA = Class N natural pozzolan, or Class F fly ash including quantity in blended cement, lb/CY.

SL = GGBFS, including the quantity in blended cement, lb/CY.

MC = minimum cementitious content, lb/CY.

X = 1.8 innocuous aggregate, 3.0 for reactive or potentially reactive aggregates.

Or

2. 25 % Class F fly ash by total weight of cementitious Material.

Option 2 mix designs are required for Project quantities in excess of the maximum quantities provided in Table 509.2.7.2:2, "Option 2: Concrete Requirements."

**Table 509.2.7.2:2
Option 2: Concrete Requirements**

Class	Compressive Strength ^A , psi	Slump ^B , Inches	Air Content ^C , %
A	3,000	4.5" – 5.5"	-
AA	4,000	4.5" – 5.5"	-
F	3,000 ^D	0.5 - 2"	-
HES	4,000 ^F	-	-
HPD	4,000	4.5" – 5.5"	-
P	3,000 ^D and 650 ^E flex	0.5 - 2"	-
G	3,000	6-9"	< 3% ^G
Special	The Contract Requirements for the individual Project will address special mix requirements.		
Notes:			
<ol style="list-style-type: none"> 1. Min specified strength shall be achieved by 28 days unless otherwise noted. 2. As determined by AASHTO T 119. 3. Project risk zone requirements apply; see Section 509.2.7.4, "Freeze-Thaw Risk Zones." 4. Min specified strength shall be achieved by 14 days. 5. Min specified average flexural strength shall be achieved by 28 days when tested in accordance with AASHTO T 97. 6. Min specified strength shall be achieved in 24 hours, and 75% of the specified strength shall be achieved in five (5) hours, unless otherwise stated in the Contract. 7. Air entraining admixtures are not allowed. 			

For both Options 1 and 2, Class G concrete shall have the following characteristics:

1. Minimum cementitious content of at least 611 lb;
2. Maximum water/cementitious ratio no greater than 0.44;
3. Combined gradation;
4. Maximum sized aggregate no greater than 0.75 in;
5. Class G mix designs using aggregates with fractured faces shall include a viscosity modifying admixture.
6. Sand/aggregate ratio between 40% and 42% by total aggregate volume;
7. Maximum air content no greater than three percent (3.0%);
8. No air entrainment agent;
9. Slump range of seven (7.0) inches \pm one (1.0) inch, except when placing under a drilling fluid;
10. Slump range of eight (8.0) inches \pm one (1.0) inch for placement under a drilling fluid; and
11. Adjust admixtures for the job site conditions encountered so that the concrete remains workable and plastic for the two (2) h placement limit.

509.2.7.3 Details for Tables 509.2.7.2:1 & 2, “Concrete Classes for Laboratory Design of Concrete Mixtures”

Tables 509.2.7.2:1 & 2, “Concrete Classes for Laboratory Design of Concrete Mixtures” shall be used for designing concrete mixes. Section 510.3.1.4, “Plastic Properties” shall be used to evaluate concrete delivered to Department Projects.

The Contractor shall use the minimum air content shown below in the Laboratory mix:

1. High Risk Zones: 7.0%
2. Medium Risk Zones: 6.5%
3. Low Risk Zones: 6.0%

All new mix designs shall have a minimum over-design compressive strength of 1,200 psi greater than the specified compressive strength. For Class F and Class P the minimum over-design compressive strength shall be 800 psi greater than the specified design strength unless a lower value is calculated using the greater value from either Equation (1) or Equation (2). Class P over-design flexural strength shall be 15% greater than the specified flexural design strength. For Class P, the minimum average flexural strength for three (3) beams cast in the Laboratory shall be 650 psi at 28 Days, when tested in accordance with AASHTO T 97. Option 1 mix designs shall not be adjust based compressive strength statistical analysis.

For Option 2 mix designs, annually the Supplier shall determine the minimum allowable average compressive strength for approved mix designs with 15 or more compressive strength tests, or for similar mix designs mixing from the same facility with the similar air content and compressive strength, and 15 or more compressive strength tests using one (1) of the following equations. The equation that produces the largest value shall be used to determine the minimum allowable compressive strength.

$$f'_{cr} = f'_c + (1.34 \times k \times s) \tag{1}$$

$$f'_{cr} = f'_c + (2.33 \times k \times s) - 500 \tag{2}$$

Where,

- f'_{cr} Minimum Laboratory compressive strength at the specified age.
- f'_c Specified compressive strength.
- k KK-factor from Table 509.2.7.3:1, "k-Factor for Increasing Standard Deviation," for standard deviation increase if the total number of tests is less than 30, but equal to or greater than 15.
- s Standard deviation for the compressive strength tests submitted of the same specified strength.

**Table 509.2.7.3:1
k-Factor for Increasing Standard Deviation**

Total number of tests	k-Factor
15	1.16
20	1.08
25	1.03
≥30	1.00

The Department will allow linear interpolation for an intermediate number of tests. A mix that was developed from a history of 15 or more test results from the preceding 24 month period is considered an existing mix. A mix developed without historical test results is considered a new mix.

509.2.7.4 Freeze-Thaw Risk Zones

The concrete mixture shall be designed for use in the freeze-thaw zone in which the Project is located. One (1) freeze/thaw cycle is defined as a Day in which the lowest recorded temperature is equal to or less than 25 °F as recorded on the Western Regional Climate Center database. The web address is www.wrcc.dri.edu. The risk levels are defined as follows:

1. **Low-Risk.** The annual average number of freeze/thaw cycles is equal to or less than 30 cycles per year;
2. **Medium-Risk.** The annual average number of freeze/thaw cycles is greater than 30 but less than or equal to 130 cycles per year; and
3. **High-Risk.** The annual average number of freeze/thaw cycles is greater than 130 cycles per year.

Table 509.2.7.4:1, "Statewide Concrete Risk Zones," shall be used to determine the required risk zone.

**Table 509.2.7.4:1
Statewide Concrete Risk Zones**

District no.	County name	Station name	Concrete risk zone
1	Dona Ana	(County wide)	Low
1	Grant	(County wide)	Low
1	Hidalgo	(County wide)	Low
1	Luna	(County wide)	Low
1	Sierra	(County wide)	Low
1	Socorro	(County wide)	Medium
2	Chaves	(County wide)	Low

**Table 509.2.7.4:1
Statewide Concrete Risk Zones**

District no.	County name	Station name	Concrete risk zone
2	Curry	(County wide)	Medium
2	De Baca	(County wide)	Medium
2	Eddy	(County wide)	Low
2	Lea	(County wide)	Low
2	Lincoln	(County wide) ^a	Medium
2	Lincoln	Ruidoso	High
2	Otero	(County wide)	Medium
2	Roosevelt	(County wide)	Medium
3	Bernalillo	(County wide) ^a	Medium
3	Bernalillo	Sandia Crest	High
3	Sandoval	(County wide)	Medium
3	Valencia	(County wide)	Medium
4	Colfax	(County wide)	High
4	Guadalupe	(County wide)	Medium
4	Harding	(County wide)	Medium
4	Mora	(County wide)	High
4	Quay	(County wide)	Medium
4	San Miguel	(County wide)	Medium
4	Union	(County wide)	Medium
5	Los Alamos	(County wide)	Medium
5	Rio Arriba	(County wide)	High
5	San Juan	(County wide)	Medium
5	Santa Fe	(County wide)	Medium
5	Taos	(County wide)	High
5	Torrance	(County wide)	Medium
6	Catron	(County wide)	High
6	Cibola	(County wide)	High
6	McKinley	(County wide) ^a	High
6	Sandoval	(County wide)	High

^aExcept as otherwise listed

The minimum allowable air content for mix design submittal purposes is:

1. Six percent (6.0%) for low-risk zones;
2. 6.5% for medium-risk zones; and
3. Seven percent (7.0%) for high-risk zones.

The air content shall be confirmed by the pressure method and the volumetric method in accordance with Section 509.2.7.6, "Mix Design Submittal."

509.2.7.5 PCC Mixture Development

509.2.7.5.1 Combined Gradation

The combined gradation procedure is required for Class F, Class P and Class HPD, and is optional for all other concrete mixes. The aggregates shall be evaluated for concrete mixtures prepared for the combined gradation procedures in accordance with the following:

1. **Coarseness Factor.** Determine the Coarseness Factor in accordance with the following equation:

$$CF = \frac{Q}{Q+I} \times 100 \tag{3}$$

Where,

CF Coarseness Factor.

Q Weight of the aggregate retained on or above the 3/8-inch sieve.

I Weight of the aggregate passing the 3/8 inch sieve, but retained on the No. 8 sieve

2. **Workability Factor.** The weight of the aggregate passing the No. 8 sieve divided by the weight of the combined gradation, represented as a percent.
3. **Mortar Factor.** The volume of the cement, SCMSCM, water, air, other pozzolans, and aggregate passing the No. 8 sieve divided by the volume of the entire concrete mixture, represented as a percent.
4. **Paste Factor.** The volume of the cement, fly ash, water, air, and other pozzolans divided by the volume of the entire concrete mixture, represented as a percent.

When using the combined gradation protocol, aggregates shall be proportioned using a 0.45 power curve to achieve a dense and uniform gradation. Coarse and fine aggregate gradation requirements do not apply. The suggested targets for the Coarseness and Workability Factors for concrete mixtures designed using combined gradation are provided in Table 509.2.7.5.1:1, "Recommended Workability Factor and Coarseness Factor Targets."

Table 509.2.7.5.1:1
Recommended Workability Factor and Coarseness Factor Targets

Nominal Maximum Aggregate Size	Workability Factor	Coarseness Factor
3/4 inch	32 - 36	65 - 75
1/2 inch	40-42	10-20

509.2.7.5.2 Concrete Mix Design Requirements

The concrete mix design shall be proportioned and designed to meet the following requirements:

1. All concrete mix design submittals shall include compressive strengths for the following specified ages:
 - 1.1 3 days;
 - 1.2 7 days;
 - 1.3 14 days; and
 - 1.4 28 days;
2. For concrete classes developed using Option 2, when examined in accordance with

the ASTM C457 linear traverse method, hardened air void system characteristics with the exception of Class G and Class HES, shall meet the following criteria:

- 2.1 A minimum air content of five percent (5.0%);
- 2.2 A specific surface greater than 600 inches⁻¹; and
- 2.3 A spacing factor less than 0.008 inch;
3. Ensure that concrete complies with Section 509.2.3.4, "Alkali-Silica Reactivity," and Section 509.2.3.4.1, "ASR Mitigation Evaluation Criteria," as determined by the State Materials Bureau;
4. For all concrete classes, chloride ion permeability at 28 Days tested in accordance with ASTM C1202 shall meet the following:
 - 4.1 Less than or equal to 3,000 coulombs for Low-Risk Zones;
 - 4.2 Less than 2,500 coulombs for Medium-Risk Zones; or
 - 4.3 Less than 2,000 coulombs for High-Risk Zones;
5. For structural concrete classes developed using Option 2, the durability index shall be determined from at least one (1) prism tested at 28 Days for 300 cycles, in accordance with ASTM C666, Method A. The mix designs shall have a minimum durability index of:
 - 5.1 80 for Low-Risk Zones;
 - 5.2 85 for Medium-Risk Zones; and
 - 5.3 90 for High-Risk Zones;
6. Cure prisms tested for durability index and chloride ion permeability by bathing in lime saturated water at a temperature of 73.3 °F ± 3.0 °F for the first seven (7) Days followed by 21 Days in lime saturated water at a temperature of 100.0 °F ± 3.0 °F; and
7. The maximum shrinkage value for Class P and HPD concrete mixtures is 0.04% at 28 Days when tested with three (3) inch x four (4) inch x 16 inch prism or three (3) inch x three (3) inch x ten (10) inch prism and cured in a standard cure for the first seven (7) Days. Following the seven (7) Day initial cure, cure in a relative humidity of 50% and test in accordance with AASHTO T 160. The results shall be reported in the "comments" field of the mix design submittal form.

509.2.7.6 Mixture Design Submittals

For standard concrete mix designs, complete electronic copy of the NMDOT *Concrete Mix Design Submittal Form* shall be submitted to the Concrete Unit of the State Materials Bureau for review and approval. Special mix designs and mix designs with Project specific shall be submitted to the Project Manager for review and approval by the State Concrete Engineer.

The following information shall be included in the mix design submittal:

1. Mix design Option;
2. Supplier name;
3. Production facility physical address, telephone number and e-mail address;
4. Production facility NRMCA Certification # and expiration date;
5. PTL's name;
6. The New Mexico registration number of the professional Engineer who is responsible for the concrete mixture design Work;
7. A comprehensive Materials list and the properties of each component, including:

- 7.1. Aggregates:
 - 7.1.1. Source names;
 - 7.1.2. Specific source locations;
 - 7.1.3. For new aggregate sources, a complete ASTM C295 "Petrographic Examination of Aggregates for Concrete" and an ASTM C294, *Constituents of Natural Mineral Aggregates* for both the coarse and fine aggregates after completing processing and manufacturing procedures and the aggregate is ready for use shall be submitted. Include the geologic origin of the Material; perform and certify the analysis using a petrographer previously approved by the Department;
 - 7.1.4. AASHTO T 11 - Soundness loss;
 - 7.1.5. AASHTO T 335 - Percent of Fractured Faces for the coarse aggregate;
 - 7.1.6. Gradations, including AASHTO T 11;
 - 7.1.7. AASHTO T 85 - Bulk saturated surface dry specific gravities;
 - 7.1.8. AASHTO T 96 - Los Angeles wear abrasion;
 - 7.1.9. AASHTO M 6 - Fineness modulus;
 - 7.1.10. AASHTO T 84 - Aggregate absorption;
 - 7.1.11. AASHTO T 152 - Aggregate correction factor;
 - 7.1.12. AASHTO T 176 - Sand equivalent of fine aggregate;
 - 7.1.13. AASHTO T 112 - Clay lumps content; and
 - 7.1.14. AASHTO T 21 - Organic impurity content, including soft fragments, coal and lignite, flat or elongated pieces, and other Deleterious substances;
- 7.2. Cement:
 - 7.2.1. Supplier name;
 - 7.2.2. Specific source name; and
 - 7.2.3. Specific cement type;
- 7.3. SCMSCM:
 - 7.3.1. Supplier name;
 - 7.3.2. Specific source name; and
 - 7.3.3. Specific SCM type;
- 7.4. Blended Cement:
 - 7.4.1. Cement supplier name;
 - 7.4.2. Specific cement source name;
 - 7.4.3. Cement type;
 - 7.4.4. SCM supplier name if different than the cement supplier name;
 - 7.4.5. Specific SCM source name;
 - 7.4.6. Specific SCM type; and
 - 7.4.7. Percent SCM;
8. Concrete mixture proportions; state clearly if submitting request under the combined gradation provisions;
9. Water/cementitious ratios;
10. Type and amount of admixtures; use admixtures on the Department's *Approved Products List*;
11. Water source and location; include pH, available alkalis, and a full chemical

- analysis, if the water source is not a certified NMED public potable water supply;
12. Plastic Concrete Properties:
 - 12.1. Air temperature;
 - 12.2. Concrete temperature;
 - 12.3. Slump; when using super-plasticizer, document the slump before and after addition of the super-plasticizer;
 - 12.4. Unit weight;
 - 12.5. Air content measured in accordance with AASHTO T 152 or AASHTO T 121; and
 - 12.6. When using super-plasticizer, document the measured air content before and after adding the super-plasticizer);
 13. Hardened Concrete Properties:
 - 13.1. New Concrete Mixtures:
 - 13.1.1. Compressive strength tests (the average of three (3) cylinders tested at three (3) Days, seven (7) Days, 14 Days and 28 Days);
 - 13.1.2. Type of fracture of each cylinder;
 - 13.1.3. Flexural strength test results for Class P (average of three (3) beams)
 - 13.1.4. Durability index (for structural mixes only);
 - 13.1.5. Hardened air void analysis (for structural mixes only);
 - 13.1.6. Rapid Chloride Permeability (for structural mixes only); and
 - 13.1.7. Expansion data from AASHTO T 303 or ASTM C1260 or C1567;
 - 13.2. Existing Concrete Mixtures:
 - 13.2.1. Resubmit original mix design, updated aggregate properties, and compressive strength statistical data when available in accordance with Section 509.2.7.6, "Mixture Design Submittals;"
 - 13.3. Incidental Concrete Mix Designs (Only for specific Projects) are concrete mixes intended for Projects that anticipate less than 150 CY of each concrete class. Incidental Mix Designs shall be proportioned in accordance with the Section and shall be approved based on the following:
 - 13.3.1. Compressive strength data (field performance data if using the mix within the previous 24 months, or Laboratory mix performance data not using it in the field); and
 - 13.3.2. Air content, as measured by the pressure method or the volumetric method; when using superplasticizer, show the air content before and after adding superplasticizer.

509.2.7.7 Mixture Design Approval

The Department will require 14 Days to review the submittal packages after receipt by the State Materials Bureau of all required information.

The Department will approve Option 1 mix designs for a period of one (1) year from the date of issuance upon verification of compliance with all requirements. Option 1 designs are required to be fully renewed each year prior to use on NMDOT Projects, or may be resubmitted under Option 2 with the additional testing required for Option 2.

The Department will approve Option 2 mix designs for a period of one (1) year from the date of issuance upon verification of compliance with all requirements. A minimum of 30 Days

before the one (1) year approval expires, the Supplier may request that the mix design be reissued. The Supplier shall provide test reports showing that the mix design met specification requirements during the issue period. Option 2 mix designs may be re-approved for no more than four (4) additional years.

At the discretion of the State Concrete Engineer, a mixture can be adjusted without re-batching by using "cement efficiency" calculations to determine the amount of change to the cement and the total cementitious content that is necessary to achieve the desired level of performance. When this procedure is allowed, the ratio of SCM to cement ratio will remain unchanged, the water content will remain unchanged, and the aggregates will be adjusted without changing the overall gradation to accommodate the changes in volume from changes made to the cement. All changes made by this method shall be approved by the State Concrete Engineer before being implemented in the field.

The approved mix design's constituent Materials shall not be changed without the State Concrete Engineer's written approval. The approved mix design's constituent Materials shall not be changed without the State Concrete Engineer's written approval.

509.2.7.8 Suspension and Revocation of Mix Design Approval

Mix design approval may be suspended by the State Concrete Engineer at any time during the approval period for any of the following reasons:

1. Unauthorized changes to the constituent Materials or proportions;
2. Conditions of the Supplier's Equipment or Quality Control adversely affects the strength or other properties of the concrete;
3. Drop in the statistical averages of the concrete below the minimums required for Acceptance in accordance with Section 510.3.5, "Acceptance;" and
4. Test cores indicate the mix is not performing as designed or is not meeting the specified design strength as determined in accordance with Section 510.3.5.4.1, "Testing Cores."

If a mix design approval is suspended or revoked, it shall not be Accepted for use on any Department construction Project.

In the event that a mix design approval is suspended for reasons 1 or 2, all of the Supplier's mix designs approvals may be suspended until such time that is demonstrated that the root cause for the suspension has been corrected.

The State Concrete Engineer will only consider a request to reinstate an approval after the Contractor has submitted and implemented a comprehensive "Corrective Action Plan" to address and correct the reason(s) for the suspension.

If the "Corrective Action Plan" fails to adequately address and correct the reason(s) for the suspension, the approval may be permanently revoked by the State Concrete Engineer. The mix design will then be required to be resubmitted in its entirety as a new mix design with updated comprehensive testing.

509.3 CONSTRUCTION REQUIREMENTS

Concrete or concrete items shall be constructed in accordance with the section of these Standard Specifications for which the concrete is used.

509.4 METHOD OF MEASUREMENT

The Department will measure concrete or concrete items in accordance with the section of these Standard Specifications for which the concrete is used.

509.5 BASIS OF PAYMENT

The Department will pay for concrete or concrete items in accordance with the section of these Standard Specifications for which the concrete is used.

SECTION 510: PORTLAND CEMENT CONCRETE

510.1 DESCRIPTION

This Work consists of placing Portland Cement Concrete (PCC).

510.2 MATERIALS

All Materials shall be tested in accordance with AASHTO and ASTM methods or other test procedures designated by the Department. The State Materials Bureau is the final authority regarding the interpretation of test procedures. The Contractor shall correct or remove and dispose of improperly graded or segregated Material that fails to meet the requirements as directed by the Project Manager and at no additional cost to the Department.

The Contractor shall only use the Materials listed on the approved mix design. The Contractor shall not substitute an approved Material or Material Source listed on the approved mix design without written prior approval by the State Materials Bureau. The Department will consider a Material change only after receiving a written request. The State Materials Bureau will review the request and provide written approval once it has verification of the equivalency of the proposed Material.

510.2.1 Portland Cement Concrete

The Contractor shall use a portland cement concrete mixture that has been reviewed and approved in accordance with Section 509, "Portland Cement Concrete Mix Designs" for the freeze-thaw risk zone in which the Project is located.

510.2.2 Aggregate

The Contractor shall use aggregates that are the same as those used on the approved mix design. The Contractor shall not use aggregate from a different source as that shown on the approved mix design.

If the concrete mixture is approved under the conventional stockpile procedures, the Contractor shall ensure the gradations comply with Table 509.2.3.2.1, "Coarse Aggregate Gradation Requirements" and Table 509.2.3.3.11:1, "Fine Aggregate Gradation Requirements."

If the concrete mixture is approved under the combined gradation procedures, the Contractor shall ensure that the most current gradations have been reviewed, and the Coarseness Factor and the Workability Factor comply with Section 509.2.7.5.1, "Combined Gradations."

510.2.3 Water

Water used for the production and curing of concrete shall conform to ASTM C1602. Water shall have a pH between six (6.0) and 8.5; sulfate or chloride contents shall not exceed 1,000 ppm, and shall be free of oil, silt, clay, organic matter, or other Deleterious Material. Non-potable water sources shall be testing tested prior to use. Residual water, wash water, or recycled water generated by Equipment, mixer trucks, or central mixers shall not be used in concrete production.

510.3 CONSTRUCTION REQUIREMENTS

510.3.1 Submittals

Thirty (30) Days prior to the start of concrete Work, the Contractor shall submit the following items to the Project Manager for review and Acceptance.

1. NRMCA Certification to include the following:
 - a. Plant inspection report;
 - b. Most recent scales calibration documentation;
 - c. Most recent liquid metering pumps calibration documentation;
 - d. Concrete uniformity test results, if required;
2. NRMCA truck certifications;
3. Approved mix designs for each concrete class used in the Project;
4. Admixture(s) Manufacturer's cut sheets;
5. Cement mill certifications;
6. SCM mill certifications;
7. Reinforcement fiber certifications; and
8. In-place strength measurement requests.

Option 1 mix designs and mix designs developed for Project specific requirements shall be submitted to the Project Manager for Project specific approval by the State Materials Bureau.

510.3.1.1 Freeze-Thaw

The Contractor shall use an approved concrete mix design which has been approved for use in a freeze-thaw zone of equal or greater risk than the zone in which the Project is located.

510.3.1.2 Class Substitution

The Contractor may substitute an approved structural class of concrete with a higher compressive strength than that of the specified class of concrete, as long as the design slump characteristics remain the same (i.e. Class HPD for Class AA, Class AA for Class A, and Class P for Class F). The Contractor shall not substitute Class A for Class AA or Class F for Class P concrete mixtures.

510.3.1.3 Alternate Batching Facilities

A request may be made to the State Materials Bureau to allow a currently approved concrete mixture to be batched out of facilities not under the direct control of the Supplier to whom the concrete mixture approval is granted. The Department will permit off-site batching of an approved concrete mixture when the following occur:

1. The Contractor shall use the same Materials as those used at the plant where the mixture is approved and as shown on the approved mix design;
2. The Contractor shall use the same admixtures as those used at the plant where the mixture is approved and as shown on the approved mix design;
3. The Contractor shall prepare a written QC plan for the alternate batch facilities, personnel and operations that adequately addresses how the alternate batch plant will assure the quality of the mixture;
4. The operations at the alternate batch facility has confirmed compliance with the approved QC plan with other mixtures; and

5. The Contractor shall provide concrete performance statistics that assure the same level of performance can be achieved from the alternate batch facilities.

510.3.1.4 Plastic Properties

The allowable slump range for non-superplasticized Class AA, Class HPD and Class A concrete is 3.5 inches \pm one (1.0) inch. The allowable slump range for Class F and Class P Slip-Formed Concrete is 1.5 inches \pm one (1.0) inch. All test procedures and frequencies will be performed in accordance with the Minimum Testing Requirements. The Contractor shall measure the air content in accordance with AASHTO T 121. The air content determined by AASHTO T 121 will be used to confirm compliance with the specified air content for structural concrete.

1. Low Risk Freeze/Thaw Zone – from 4.5% to eight percent (8.0%);
2. Medium Risk Freeze/Thaw Zone – from five percent (5.0%) to eight percent (8.0%);
or
3. High Risk Freeze/Thaw Zone – from 5.5% to eight percent (8.0%).

510.3.1.5 Troubleshooting

If the concrete produced using approved mix design fails to meet requirements, the Project Manager will immediately notify the Contractor and the State Concrete Engineer. The Contractor shall be responsible for notifying the Supplier and the Private Testing Laboratory (PTL) that designed the mixture. The PTL shall work with the State Concrete Engineer to make the necessary changes to resolve the problems. Efforts to evaluate problems with the concrete do not relieve the Contractor of the responsibility to provide a concrete mixture that meets Project requirements.

If the compressive strengths do not comply with Department requirements, the Contractor shall describe the needed adjustments. The Contractor shall submit a written summary of the adjustments to achieve compressive strength to the State Materials Bureau for approval.

The mix design approval may be suspended or revoked by the State Concrete Engineer should concrete continue failing to meet requirements in accordance with Section 509.2.7.8, "Suspension and Revocation of Mix Design Approval." The Project Manager will notify the Contractor immediately should the mix design's approval status be under review.

510.3.2 Batching

The Contractor shall produce ready-mixed concrete and site-mixed concrete in accordance with AASHTO M 157, Sections nine (9) to eleven (11).

510.3.2.1 Portland Cement Concrete Production Facilities

The concrete production facilities shall be certified in accordance with the National Ready Mix Concrete Association (NRMCA) Plant Certification Program. The Project Manager will review and Accept facilities and Equipment certifications and calibrations before production operations begin.

The concrete production facilities shall have clearly separated aggregate bins or stockpiles; silos for cement and SCM; weighing hoppers; and scales. Batch plants shall be equipped to proportion aggregates, bulk cement and SCM using calibrated weighing devices. If weighing SCM on the same scale as the portland cement, the Contractor shall weigh the cement first, then add the SCM.

The Contractor shall ensure that the batch plant operator has a direct view or live video of each scale and admixture sight tube while preparing batches of concrete. The Contractor shall ensure that the batch plant is capable of:

1. Accurately weighing and batching Materials for the portland cement or portland cement/SCM concrete mixture within the tolerances specified;
2. Providing readily visible scale dials or instrumentation devices for admixture bottles, beam scales and load cells, even if using a computer to prepare the batch; and
3. Using weighing hoppers of sufficient size to contain the Material without loss or spillage.

The Contractor shall use weighing hoppers that efficiently discharge weighed Materials for each batch. The Contractor shall ensure that the Material charging Equipment can deliver the batch to the mixer without loss or spillage. The Contractor shall provide scales for weighing aggregates, cement, water, and SCM in accordance with Section 109.1, "Measurement of Quantity."

510.3.2.2 Cementitious Materials

Cementitious Materials shall be weighed bulk cementitious Materials using a scale that has been calibrated in accordance with NRMCA requirements except when continuous proportioning and mixing Equipment is used. Partially used packaged cementitious Materials shall be weighed prior concrete batching.

Cement, and combined cementitious weights shall be within \pm one percent (1.0%) of the target weights. If the weight of cementitious Materials is expected to weigh less than 1,000 lb, the weighed Materials shall be within 30 lb of the target weight.

If the Material varies from the target weight by more than \pm one percent (1.0%), the Department will immediately notify the Contractor to take corrective action. If the weight is no more than two percent (2.0%) above or two percent (2.0%) below the target weight, the Department may, at the Project Manager's discretion, Accept a maximum of five (5) loads out of the first ten (10) consecutive loads of concrete delivered of any continuous placement with these weight discrepancies, regardless of whether the discrepancies are for the same Material or for other weighed Materials. Any batches of concrete produced after the first ten (10) have been batched that have cement or total cementitious weights that are more than \pm one percent (1.0%) will be rejected and not allowed to be placed on the Project. The Contractor shall dispose of rejected loads at no additional cost to the Department.

Scales and hoppers shall be equipped with a device that indicates the complete discharge of cement and SCM into the mixer. Bulk cement and SCM shall be stored in weather tight bins and weighing hoppers. Discharge chutes shall not be suspended from the weighing hoppers. Discharge chutes shall be arranged so that cement and SCM do not lodge in or leak from them.

Different cementitious Materials shall be stored separately, protected from moisture. Different brands or types of cement, SCM, or blended cement from different production facilities shall be stored separately. Separate, and identifiable storage shall be provided for blended Portland-SCM cement storage at the Project or plant site.

510.3.2.3 Water

Mixing water consists of free water, ice added to the batch and surface moisture on the aggregates. Prior to placement, the amount of water added by the addition of ice shall be

measured, recorded, and used to calculate the concrete mixture's water:cement ratio. The total amount of water, including water add at the Project site, shall be no more than 1.5% greater than the amount required by the approved mix design. For truck mixers, the Contractor shall discharge the wash water before loading the next batch of concrete.

510.3.2.4 Aggregates

510.3.2.4.1 Stockpiles

The Contractor shall ensure the separation of stockpiles of different sizes or from different sources. The Contractor shall stockpile aggregates so that the coarse and fine particles do not separate. The Contractor shall provide stockpiles that can produce enough concrete for the section constructed during a scheduled operation. The Contractor shall ensure that aggregates are not contaminated by Material from adjacent stockpiles or from contact with the ground, dust, or other Deleterious Materials. The Contractor shall not use aggregates that become segregated or mixed with Deleterious Material. The Contractor shall not use frozen lumps of aggregate in concrete batching.

The Contractor shall ensure that a "sacrificial" layer of the same size aggregate at least six (6) inches deep is maintained below the bottom of the stockpile so that the front-end loader will not pick up non-complying Materials that would contaminate the concrete mixture.

510.3.2.4.2 Aggregate Properties and Gradations

All gradation tests performed to fulfill the requirements of this section must be performed by TTCP certified technicians.

The Project Manager may cancel concrete placements that have gradation data that is more than seven (7) Days old.

1. The Contractor shall provide new gradation results to the Project Manager in accordance with Section 906, "Minimum Testing Requirements."
2. If the mixture design is approved with the Conventional Stockpile Procedure, the Contractor shall ensure that the stockpile gradations comply with the standard gradation requirements for each sieve size shown in Table 509.2.33.2.3:1, "Coarse Aggregate Gradation Requirements," and Table 509.2.33.3.3:1, "Fine Aggregate Gradation Requirements."
3. If the mixture design is approved with the combined gradation procedure, it is the Contractor's responsibility to continuously monitor the gradation of each of the stockpiles.
4. The Contractor's responsibilities to monitor gradations are not related to the QC/QA testing requirements. The Department considers these responsibilities to be part of the standard operation and maintenance of the batching facilities.
5. The Contractor shall determine if the combined gradation is within the following limits:
 - 5.1. Coarseness factor is \pm three (3) percentage points of the value in the approved mixture design;
 - 5.2. Workability factor is \pm two (2) percentage points of the value in the approved mixture design.
6. The aggregate batch weights shall be automatically adjusted when the gradation information determined by the Supplier is entered into the Field Report form. The Supplier will be required to use the most recent gradations to determine if the

Coarseness Factor or the Workability Factor does not comply with 5.1 or 5.2 above. If the Coarseness Factor or the Workability Factor does not comply with 5.1 or 5.2 above, the mix batch weights must be adjusted to bring these factors into compliance. When adjusting these factors, adjust them to the tolerances in 6.1 and 6.2, below.

- 6.1. Coarseness factor is \pm two (2) percentage points of the value in the approved mixture design;
 - 6.2. Workability factor is \pm 1.5 percentage points of the value in the approved mixture design.
7. If the gradation tolerances in 5.1 and 5.2 cannot be met, the Contractor shall not place concrete until the Material is corrected to meet the specified gradation tolerances.

510.3.2.4.3 Batch Weights

The Contractor shall batch aggregate target weights over 1,000 lb to within \pm two percent (2%) of the target weight. For target weights less than 1,000 lb, the Contractor shall batch to within \pm 50 lb of the target weight.

If any of the first ten (10) loads of concrete have a fine or coarse aggregate weight that differs from the target weight by more than two percent (2%), but not more than \pm three percent (3%), the Department may, at the Project Manager's discretion Accept the concrete. The Department will allow no more than five (5) loads out of the first ten (10) consecutive loads of concrete of any continuous placement to exceed the maximum allowable weight tolerances. Any batches produced after the first ten (10) that differ from the target weight by more than \pm two percent (2%) will be rejected from the Project and shall not be placed on the Project. The Contractor shall dispose of rejected loads at no additional cost to the Department.

510.3.2.4.4 Moisture Control

1. For a manually operated facility or for hoppers not equipped with automatic moisture sensors, the Contractor shall measure the moisture content of each stockpile not monitored by automatic moisture sensors at least every four (4) hours, or as required by changing moisture conditions within the stockpiles.
2. For plants equipped with automatic moisture probes, for each stockpile monitored by an automatic moisture probe, the Contractor shall measure moisture content manually at least once a Day. The Contractor shall compare the manual measurement immediately before preparing the first concrete load to the measurement shown by the moisture sensing Equipment. If the measurements differ by more than 0.5%, re-correlate the moisture probe.
 - 2.1 For stockpiles not monitored by an automatic moisture probe, the Contractor shall follow the requirements of bullet 1 above.
3. The Contractor shall send a certificate showing the moisture content determined by manual methods in accordance with bullet 4 below, and the moisture correlation to the Project Manager with the first load of concrete. If this information is not included with the first load of concrete delivered to the Project, that load of concrete and all subsequent loads of concrete are subject to rejection until the information is received at the Project.
4. The Contractor shall determine the aggregate moisture content to the nearest 0.5% in accordance with one (1) of the following procedures:

- 4.1 AASHTO T 217: The shelf life of the calcium carbide is relatively short. Closely monitor the age of the calcium carbide and replace it in strict accordance with the manufacturer's recommendations;
- 4.2 AASHTO T 255: The Department will allow the hot-plate or microwave methods for this purpose, as long as no Material is lost and the pan is continuously agitated during the drying process.
5. The Contractor shall provide the following information on the moisture certificate to the Project Manager:
 - 5.1 Pan weight;
 - 5.2 Wet weight of the pan and the sample;
 - 5.3 First dry weight of the pan and the sample;
 - 5.4 Second dry weight of the pan and the sample;
 - 5.5 Third dry weight of the pan and the sample (if necessary);
 - 5.6 Absolute moisture content of the sample;
 - 5.7 The moisture probe reading from the tested sample (if equipped); and
 - 5.8 The calculated difference between the actual moisture content test and that shown by the moisture sensing Equipment.

The Contractor shall allow washed aggregates to drain before use. The Project Manager may require the aggregates to remain in the stockpile or storage area for longer, if the moisture contents are excessive.

510.3.2.5 Air-Entraining and Chemical Admixtures

The Contractor shall store admixtures in separate containers to avoid contamination, evaporation, and damage. The Contractor shall protect liquid admixtures from freezing and from damaging temperatures. For admixtures used as suspensions in non-stable solutions, the Contractor shall provide agitating Equipment to ensure the thorough distribution of the ingredients. All admixtures listed on the approved mix design shall be included in the concrete mixture; specific admixture proportions maybe adjusted to meet Project specific conditions or requirements. All admixtures added by hand and/or at the Project site will be documented by the Department on the batch tickets.

510.3.2.6 Pigment Admixtures for Integrally Colored Concrete

The Contractor shall follow the manufacturer's instructions in handling, storing, and mixing pigments. The Contractor shall deliver pigments to job site or batch plant in original, unopened packaging. The Contractor shall store in dry conditions.

The Contractor shall submit product data and manufacturer's instructions for pigment use and submit product samples or mock-ups to the Project Manager for approval. If required by the Contract and/or if requested by the Project Manager, the mock-up panels shall include samples of rubbing and patching. The Contractor shall allow 30 Days for submittal approval and 14 Days for each necessary resubmittal. The color of the approved samples or mock-ups shall be used as a control for the Acceptance of the installed Material. Bulk Materials for this portion of the Project should not be purchased until the Project Manager has approved the samples or mock-ups.

510.3.2.7 Mixing

The Contractor shall ensure that the uniformity of the concrete mixture complies with AASHTO M 157, Section 10.2. If using a central plant mixer it must have a rated mixing capacity of at least three (3) CY. The Contractor shall batch and deliver concrete in accordance with NRMCA Standards.

510.3.3 Transporting

The Contractor shall transport mixed concrete in non-agitating trucks only when the slump is less than two (2) inches. Revolving-drum mixer trucks shall be used to transport concrete with a slump in excess of two (2) inches. The Contractor shall transport concrete produced in a dry-batched concrete plant in revolving-drum mixer trucks. Non-agitator, mixer and agitating trucks used for transporting concrete shall be annually certified by NRMCA. Upon request, the Contractor shall provide the Project Manager documentation of current NRMCA certification for each transport truck used on the Project.

510.3.3.1 Non-Agitator Trucks

The Contractor shall use only non-agitating trucks with bodies that are smooth, mortar-tight metal containers capable of discharging the concrete at a satisfactory controlled rate without segregation. The Contractor shall provide covers needed for protection.

510.3.3.2 Truck Mixers and Agitators

The Contractor shall equip agitator trucks with a plate directly attached to the truck in a readily visible location, labeled with the specific truck properties, including the designated drum mixing speed.

Department personnel will check the water tank site tube when the truck arrives at the Project site. If there is water missing from the tank, the Department will reject the truck unless the Driver can account for the missing water.

510.3.3.3 Arrival at the Project

The Contractor shall re-mix the concrete that arrives at the Project site in agitator trucks as follows:

1. For concrete mixed in a central mix plant: mix at the designated mixing speed for a minimum of two (2) min, before discharging;
2. For concrete mixed inside an Agitator Truck: mix at the designated mixing speed for a minimum of five (5) min, before discharging; and
3. If any water, water-reducing admixtures, entrained air, or other ingredients are added to the concrete, mix the additional Material at the designated mixing speed for at least five (5) min before discharging.

510.3.4 Placing

510.3.4.1 Temperature and Weather Limitations

See Section 511.3.44, "Temperature and Weather Limitations."

510.3.4.2 Mixing Time

"Mixing time" is the elapsed time from when the cement is exposed to the aggregates until the concrete has been placed into its final location. The Contractor shall not use concrete mixed less than the minimum specified time. The maximum mixing time for concrete hauled in

truck mixers or truck agitators is 90 min. The Contractor shall not exceed 60 min of mixing time when:

1. The concrete temperature is 80 °F or above for Bridge decks or approach slabs, and
2. The concrete temperature is 85 °F for other concrete.

When hauling the concrete in non-agitating trucks, all concrete must be placed into its final location within 45 min of initial mixing. If the concrete temperature is 80 °F or above, the Contractor shall, place concrete within 30 min from initial mixing.

Concrete arriving at the Project with a temperature greater than 90 °F shall be rejected for use on the Project.

510.3.4.2.1 Extended Mixing Time

In rural and remote areas of the State where mixing time cannot be met, the Contractor shall submit a written request to the Project Manager for additional time. The Contractor shall include the following information:

1. The reason for requesting additional time;
2. The additional time needed in excess of the specified mixing time;
3. The proposed procedures, methods, and type of Materials or admixtures to be used, and the ambient temperature range to be considered, so that the concrete will meet required fresh and hardened properties; and
4. Documentation to prove that the additional time will not damage the quality of the concrete. Documentation shall include admixture technical data.

This information will be forwarded to the State Concrete Engineer for review. The State Concrete Engineer will issue a written recommendation within 14 Days from receipt of the request.

If the Department allows a mixing time extension, the Contractor shall prepare a trial batch consisting of at least one (1) full load of concrete at the designated production facility and haul to the Project site. The Contractor shall batch the concrete in the same quantities as anticipated for the Project. The Contractor shall place the trial batch in a non-critical application to assess the mixture. If dosage for the admixture used for extending mix time is found to provide an initial setting time 30 minutes or more after the concrete has been unloaded, then the admixture will be approved for use by the Contractor at the dosage determined from the trial.

510.3.4.3 Concrete Sampling and Testing

The Contractor shall test for Quality Control and the Department will test for Acceptance in accordance with Division 900, "Quality Criteria" and as specified in this Section. The Contractor Quality Control Field Technicians shall be certified by ACI or TTCP.

1. The Contractor shall test the concrete for compliance and Acceptance in accordance with Section 906, "Minimum Testing Requirements." The Contractor shall obtain representative samples of concrete being tested for the required properties from the point of discharge into the Structure being placed. The Department will provide test results to the Contractor after the final compressive strength tests for each set of test specimens is completed with a copy to the Supplier on a weekly basis.

2. The Contractor shall mold and cure concrete cylinders for compressive strength tests in accordance with AASHTO T 23, *Making and Curing Concrete Test Specimens in the Field* using four (4) inch × eight (8) inch single use plastic cylinder molds with plastic lids. The Contractor shall use cylinder molds that are six (6) inch × 12 inch if the nominal maximum size of the aggregate is equal to or greater than 1.5 inch.
3. The Contractor shall use a rod to consolidate the concrete for all slump, air content and unit weight tests and all compressive strength test cylinders cast with normal slump concrete. For Class F and P, the Contractor shall use a vibrator to consolidate the concrete in all air content and unit weight tests and all test cylinders cast from slip form concrete. The Contractor shall not use a rod to consolidate slip-form concrete.
4. Prior to any concrete placement or multiple concrete placements with differing location(s), the Contractor, Supplier and Project Manager shall agree upon in writing the location(s) of the initial curing station(s) for concrete cylinders. If a pre-concrete placement conference is required, the location(s) of the initial curing station(s) shall be a required item of discussion. The Project Manager will not agree to any initial curing location that will jeopardize the integrity of the test specimens during subsequent transport to the initial curing location. The curing station may be relocated should the current location cause a detrimental effect to the Project as agreed upon by the Contractor, Supplier and Project Manager. The new location shall be designated by the Contractor, Supplier and Project Manager.
5. The Contractor shall provide all necessary support at the agreed upon initial curing location(s) for all testing and to maintain sufficient safe storage space, including but not limited to water bath container, water for initial curing of concrete cylinders, heating or cooling as necessary, generators (and alternate power sources, as needed) and all vibratory Equipment and all Equipment required to operate the vibratory Equipment as required by this Section.
6. Immediately after molding, the concrete test cylinders shall be transported vertically, in a water filled container to the initial curing station. The Contractor shall begin curing of test cylinders by placing them in a water bath with a temperature of 70 °F ± ten (10) °F.

The Contractor shall maintain the water-filled containers with the test cylinders undisturbed for a minimum of 21 h, but not more than 48 h, from the time of placement. The Contractor shall ensure that the level of water never drops below the tops of the cylinders.

Water baths for both Quality Control and Acceptance testing shall be provided and maintained by the Contractor. Cylinders shall be appropriately marked to differentiate between Quality Control and Acceptance testing.
7. After initial curing, the Contractor shall strip the concrete cylinders and place into a standard curing tank (or moist room) in accordance with AASHTO T 23, Section 10.1.3. If the cylinders are to be shipped to an off-site Laboratory for testing, the Contractor shall maintain the cylinders in the standard curing environment at a temperature of 73 ± three (3) °F until they are ready to be transported. The Contractor shall not ship test cylinders until they are at least 48 h old.
8. The party that prepared the test specimens shall be responsible for transporting them from the initial curing station to the final curing location. The Contractor shall protect the test specimens from being damaged in any way. Specific attention will be paid to protection from sun, wind, rain, vibrations, moisture loss and any sudden drops or impacts during transport.

510.3.4.3.1 Testing Frequency

Department personnel will perform all testing in accordance with the Minimum Testing Requirements as defined in Section 906, "Minimum Testing Requirements."

510.3.4.3.2 Continuous Concrete Placements

As concrete is being placed and tested, concrete tests which are outside the allowable concrete test ranges may be encountered and shall be immediately reported to the Project Manager. Continuous concrete placement shall be stopped if the slump is more than one (1) inch over the specified limits or air is more than 0.5% below the minimum allowable air content and the remainder of the that was being placed shall be rejected. The next consecutive load shall then be tested for plastic properties. In the event that two (2) consecutive trucks or any two (2) out of six (6) trucks are outside the allowable testing ranges, concrete shall not be placed in the Structure until the concrete testing is performed prior to the placement operation and the allowable concrete test ranges are shown to be in the allowable range. Continuous concrete placement shall only resume if concrete from five (5) consecutive trucks are delivered within allowable concrete testing parameters, then the placement and testing of concrete can once again be performed concurrently.

Concrete that has been placed with air content less than 0.5% below the minimum allowable air content or slump less than one (1) inch over the specified limits shall be subject to an additional price reduction of \$50/CY. Concrete with air content more than 0.5% below the minimum allowable air content or slump greater than one (1) inch over the specified limits shall be rejected. This shall be in addition to the outcome of the final pay factors for concrete.

510.3.4.4 High Range Water Reducer

If using a high range water reducer (commonly referred to as superplasticizers), the Contractor shall measure the initial slump before adding the high range water reducer, and again immediately after the high range water reducer has been properly mixed into the load. The Contractor shall not exceed slump Specifications defined on the approved mixture design before introducing the high range water reducer. The Contractor shall not exceed a slump of eight (8) inches after adding the high range water reducer. The Contractor shall check adjusted concrete for segregation before and during placement. The Contractor shall not place segregated concrete.

510.3.5 Acceptance

510.3.5.1 Concrete Strength

The Department will determine the compressive strength for compliance by averaging two (2) or more concrete cylinder test results from the same concrete sample and tested at the specified age. The Department will make, handle, and store cylinders in accordance with AASHTO T 23 and test in accordance with AASHTO T 22. The Department will consider the result from a single cylinder only as an indicator. It will not be considered an actual strength measurement. Any on-site storage facilities shall be provided by the Contractor.

510.3.5.1.1 Individual Strength Test

Unless otherwise specified, the Department will verify compliance with the Specifications by determining the concrete strength at the age specified in Section 509.2.7.1, "Concrete Classifications." The cylinders tested at the specified age will be used to determine the Individual Strength Test result. The Department will make four (4) cylinders for each test set. The first cylinder shall be tested at seven (7) Days. Two (2) cylinders shall be tested at the specified age. The forth cylinder will be held in reserve for testing if the Within-Test-

Coefficient-of-Variation exceeds five percent (5%), as determined in accordance with ACI 214.3.4.1.

If the fourth cylinder is tested, the Department will average all of the cylinders tested at that age to determine the Individual Strength Test, unless any of the following conditions exist:

1. There is a visible cylinder defect or a defect in the capping.
2. A significant irregularity occurred while loading the test specimen to failure, such as a sudden load burst, cyclic or pulsating loads, or a loading rate not in accordance with AASHTO T 22.

510.3.5.2 In-Place Concrete Strength Measurements

If the Contractor requests measurement of in-place concrete strength for construction-related purposes, the Contractor shall provide testing Equipment and perform strength tests at no additional cost to the Department. Field cured test cylinders shall be tested by a PTL approved by the State Materials Bureau. The Contractor may use one of the following procedures to determine the in-place concrete strength. Prior to using any of the procedures listed in this Section, and no later than 30 Days prior to concrete placement, the Contractor shall submit an In-Place Concrete Strength Measurement Plan, complete supporting documentation, and procedures for the proposed method to the Project Manager for approval by the State Materials Bureau.

1. AASHTO T 23 – Cure molded cylinders in accordance with T 23 - Section 10.2.1;
2. ASTM C805 – Rebound Number of Hardened Concrete (Rebound Method): As modified herein. This procedure shall be performed in accordance with directions from the State Concrete Engineer. At a minimum, a test shall consist of at least 14 credible rebounds obtained from an area approximately 18 inches in diameter. The highest two (2) and the lowest two (2) rebounds will be deleted and the remaining ten (10) rebound results averaged to determine the rebound number from the test location;
3. ASTM C873 – Compressive Strength of Concrete Cylinders Cast In-Place in Cylindrical Molds;
4. ASTM C900 – Pullout Strength of Hardened Concrete;
5. ASTM C1074 – Estimating Concrete Strength by the Maturity Method. The maturity curve shall be developed on site during the first curing period of the first concrete placement on the Project. This shall be performed each concrete class and/or concrete mix design used on the Project for which the Maturity Method will be used; or
6. Match-Cure Method – Places additional molded cylinders into a specially controlled chamber that maintains the temperature of the cylinders to that of the concrete represented.

In-place strength measurement will not be used for Final Acceptance or to determine the pay factor. The Contractor shall not use ASTM C805, C873 or C900 for in-place strength measurements of concrete contained in Bridge decks, prestressed members, approach slabs, or the top slabs of CBCs that are defined as Bridges. The Department will not allow any samples to be taken from Bridge decks, prestressed members or approach slabs.

510.3.5.3 Compressive Strength of Concrete Based on Cylinders for Payment

The Department will Accept for payment purpose concrete based on the compressive strength cylinder tests when the compliance tests equal or exceed the specified strength. If

the compliance test is less than the specified strength, the test will be considered Acceptable if both of the following requirements are met:

1. The running average of three (3) consecutive individual strength tests, as determined by the Department's Performance Data Sheet for the concrete used on the Project, which meets or exceeds the specified strength; and
2. No Individual Strength Test as defined in Section 510.3.5.1.1, "Individual Strength Test" falls below the specified strength by more than 15%.

If the compliance tests are not 100% or more of the specified strength, the Department will review the tests and notify the Contractor whether the concrete will be Accepted at a reduced price, or if it has been "rejected." The Department will only allow rejected concrete to remain in place based on an engineering analysis. Concrete that is rejected shall be removed and replaced at the Contractor's expense and time.

510.3.5.4 Investigation of Low Strength Cylinder Test Results

The Contractor shall not use the following test procedures as a substitute for the compliance test program in Section 510.3.4.3, "Concrete Sampling and Testing."

If problems with low strength cylinder tests persist, the Department may suspend the Project at no additional cost or time to the Department and require the Contractor to comply with Section 510.3.1.5, "Troubleshooting." If the corrective actions taken by the Contractor are insufficient, the Department may suspend Work again, at no additional cost or time to the Department, until the Project Manager determines Acceptable action as proposed by the Contractor.

Should the Contractor elect to investigate low strength cylinder test results, the Contractor shall submit a Low Strength Investigation Plan no later than 35 Days (28 Days for Class F or Class P concrete) after the date of placement to the Project Manager for permission to use the selected method. The Low Strength Investigation Plan will be reviewed for Acceptance by the State Materials Bureau and returned to the Contractor within seven (7) Days of receipt. The Contractor shall not proceed until receipt of written approval from the State Materials Bureau. The Contractor shall complete the low strength investigation no later than 56 Days after the date of concrete placement. The Contractor will Accept and not dispute the test results of low strength cylinders if the Low Strength Investigation Plan is not submitted within the allotted time.

The Contractor may use any of the in-place strength test methods listed below to investigate areas of concern if normal Acceptance tests do not comply with Section 510.3.5.3, "Compressive Strength Compliance of Concrete Based on Cylinders."

1. AASHTO T 24 – Obtaining and Testing Drilled Concrete Cores and Sawed: Perform in accordance with Section 510.3.5.4, "Investigation of Low Strength Cylinder Test Results;"
2. ASTM C803 – Penetration Resistance of Hardened Concrete (Windsor Probe);
3. ASTM C805 – Rebound Number of Hardened Concrete (Rebound Method): As modified herein. This procedure must be performed in accordance with directions from the State Concrete Engineer. At a minimum, a test shall consist of at least 14 credible rebounds obtained from an area approximately 18 inches in diameter. The highest two (2) and the lowest two (2) rebounds will be deleted and the remaining ten (10) rebound results averaged to determine the rebound number from the test location.

ASTM C803 and C805 will not be used for Final Acceptance or to determining pay factors. For Bridge concrete, test cores shall not be taken from Bridge decks, prestressed members, approach slabs, or the top slabs of CBCs that are defined as Bridges unless specifically approved by the State Bridge Engineer. For all other Bridge concrete with low strength test results, the Bridge Design Section will develop a Coring Plan within seven (7) Days of receipt of the Low Strength Investigation Plan. The State Materials Bureau may consider Contractor requests to use other industry accepted investigation methods not listed in this Section for investigation of low strength cylinder test results and Final Acceptance purposes.

510.3.5.4.1 Testing Cores

If the Contractor requests to use cores to determine in-place compressive strength, the cores shall be obtained in accordance with AASHTO T 24. The Contractor shall complete coring no later than 49 Days after the date of concrete placement. The Contractor shall take three (3) cores from any area of concern to evaluate the area that had low strength test results, and immediately seal each core separately in an air tight plastic bag. The Department will take immediate possession of the cores for testing by the State Materials Laboratory. Cores will be tested for compressive strength no later than 56 Days after the date of concrete placement.

Results of the core testing will be binding on both the Contractor and the Department, and will replace the results of the test cylinders for that sample.

510.3.5.5 Price Adjustments

Concrete that is less than 100%, but is greater than 85% of the specified strength shall have the reduced in price in accordance with Table 510.3.5.5:1, "Pay Factors Based on % of Specified Strength."

**Table 510.3.5.5:1
Pay Factors Based on % of Specified Strength**

Specified Strength, %	Pay Factor, %
97 - 99	98
94 - 96	96
91 - 93	92
88 - 90	84
85 - 87	75
Less than 85%	Reject ^A

^AThe Department will only allow rejected concrete to remain in place based on an engineering analysis Accepted by the Department. A 50% pay factor will be applied to rejected Material that is allowed to remain in place. Otherwise, rejected Material shall be removed and replaced at no additional expense to the Department.

If the compliance strength test is 85% or more of the specified strength then the Contractor may request to have a Hardened Air Content Test on a core obtained from the concrete in question. The Contractor shall obtain the core in accordance with AASHTO T 24 and immediately seal it in a plastic bag. The Department will take immediate possession of the core, for evaluation by a Department approved Petrographer in accordance with ASTM C457, linear traverse method. If the result of the hardened air content analysis meets the requirements below, the concrete will be paid for at full price:

1. A minimum air content of five percent (5.0%);
2. A specific surface greater than 600 inches⁻¹; and

3. A spacing factor less than 0.008 inch.

510.4 METHOD OF MEASUREMENT

The Department will measure concrete or concrete items in accordance with the section of these Standard Specifications for which the concrete is used.

510.5 BASIS OF PAYMENT

The Department will pay for concrete in accordance with the Section of these Standard Specifications for which the concrete is used.

SECTION 511: CONCRETE STRUCTURES

511.1 DESCRIPTION

This Work consists of constructing concrete box Culverts, headwalls, retaining walls, abutments, bents, piers, slabs, girders, and Incidental Structures requiring the use of concrete, except pre-stressed members.

511.2 MATERIALS

When waterproofing is required by the Contract but a type is not specified, either fluid-applied waterproofing or sheet membrane waterproofing shall be used.

511.2.1 Portland Cement Concrete

The Contractor shall use concrete mixes that have been designed in accordance with Section 509, "Portland Cement Concrete Mix Designs" and approved for use on NMDOT Projects by the State Materials Bureau for the freeze/thaw risk zone in which the Project is located. A higher risk zone concrete may be substituted.

511.2.1.1 Concrete Surface Finishing Materials

For Class 2 Surface Finish, the Contractor may use a thin mortar composed of one (1) part cement and four (4) parts sand passing the No. 16 sieve. The cement used in the thin mortar shall be of the same type and source as that used in freshly placed concrete.

Alternatively, the Contractor may use a prepackaged, polymer modified mortar, designed specifically for concrete surface finishing with a minimum 28 day compressive strength of 2,000 psi per ASTM C109.

511.2.2 Steel Reinforcing

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

511.2.3 Bonding Agent

The Contractor shall use a bonding agent that meets the requirements of ASTM C1059, Type II or C-881 Type V.

511.2.4 Form Release Agent

The Contractor may use form release agents at their discretion. Compatibility must be confirmed in a letter from the Manufacturer of subsequent surface treatments including but not limited to penetrating water repellent treatment, stains, and/or paints. If compatibility cannot be confirmed, form release residue shall be removed per the surface preparation recommendations of the manufacturer of the subsequent product.

When integrally colored concrete is used, the Contractor shall use form release agents that are non-staining and minimize surface imperfections of concrete.

511.2.5 Liquid Applied Evaporation Reducers

Unless otherwise specified in the Contract documents, the Contractor may utilize liquid-applied evaporation reducers to reduce the effects of excessive rate of evaporation at the

surface of plastic concrete. Evaporation reducers shall be commercially available water-based compounds that are specifically designed to form a thin monomolecular film to reduce rapid moisture loss from the concrete surface prior to curing. The product shall be certified to have no adverse effects on the cement hydration process or the concrete and that it reduces surface moisture evaporation from the concrete when performing concrete operations in direct sun, wind, high temperatures, and/or low relative humidity.

511.2.6 Curing Materials

511.2.6.1 Liquid Membrane Forming Compounds

The Contractor shall use Type 1-D or Type 2 liquid membrane-forming concrete curing compounds that comply with ASTM C 309.

When integrally colored concrete is used, the Contractor shall use only curing compounds specifically recommended for use with colored concrete and in accordance with ASTM C309 Type 1.

511.2.6.2 Linseed Oil Emulsion

The Contractor shall not use linseed oil emulsion-curing agent.

511.2.6.3 Sheet Materials for Curing Concrete

The Contractor shall use concrete curing sheet Materials in accordance with AASHTO M 171. The Department will only allow the white reflective type.

511.2.7 Joint Materials

The Contractor shall provide joint filler Material in accordance with AASHTO M213 or AASHTO M153 Type I or IV (no cork).

The Contractor shall provide liquid-applied joint sealant in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints" at non-Bridge joint locations.

511.2.8 Extruded Polystyrene

The Contractor shall provide extruded polystyrene that complies with ASTM C578 Types X or XII (15 psi), Type IV (25 psi), or Type VII (60 psi). If strength is not shown in the contract, the Contractor shall use Type IV (25 psi). Extruded or expanded polystyrene may be used interchangeably.

511.2.9 Tear-Web Waterstop

Waterstop at the joint between abutment cap and abutment diaphragm shall be tear-web waterstop. The Contractor shall provide a product that meets the requirements of Table 511.2.9:1, "Tear-Web Waterstop Requirements."

**TABLE 511.2.9:1
Tear-Web Waterstop Requirements**

Typical Properties	ASTM Method	Minimum Value
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**TABLE 511.2.9:1
Tear-Web Waterstop Requirements**

Typical Properties	ASTM Method	Minimum Value
Water Absorption	D-570	0.10%
Tear Resistance, lb/in	D-624	225
Specific Gravity, (+/-0.05)	D-792	1.38
Hardness, Shore A (+/-5, 10 sec. delay)	D-2240	80
Tensile, psi	D-638, Type IV	2000
Elongation %	D-638, Type IV	350
Low Temperature Brittleness @ - 35° F	D-746	No Failure
Stiffness in Flexure, psi	D-747	600
Accelerated Extraction, USACE CRD-C572		
Tensile, psi	D-638, Type IV	1600
Elongation, %	D-638, Type IV	300
Effect of Alkali, USACE CRD-C572		
Weight Change, %	-----	+0.25%, -0.10%
Change in Hardness, Shore A	D-2240	+/-5 points

511.2.10 Sheet Membrane Waterproofing

When specified in the Contract documents, the Contractor shall install waterproof membrane Materials. For this application, the Contractor shall provide flexible, sheet membrane waterproofing Material that is a minimum 50 mil thickness. Compatible surface primers, adhesives and flashings shall be used as recommended by the manufacturer's application instruction. The Material shall meet the requirements of Table 511.2.10:1, "Sheet Membrane Waterproofing Requirements."

**TABLE 511.2.10:1
Sheet Membrane Waterproofing Requirements**

Typical Properties	ASTM Method	Value
Water Vapor Permeance	ASTM E96	0.05 perms max
Elongation	ASTM D412	300% min
Tensile Strength	ASTM D412	300 psi min
Peel Strength	ASTM D903	8 lbs/in min
Puncture Resistance	ASTM E154	45 lbf min

511.2.11 Fluid-Applied Waterproofing

When specified in the Contract documents, the Contractor shall install cold, fluid-applied waterproof membrane Materials on concrete walls prior to backfill. For this application, the Contractor shall provide seamless rubberized asphalt membrane at a minimum thickness of 30 mils. Compatible surface primers, and joint, crack, and corner treatments shall be used as recommended by the manufacturer's application instruction. The Material shall meet the

requirements of Table 511.2.11:1, "Fluid-Applied Waterproofing Requirements."

**TABLE 511.2.11:1
Fluid-Applied Waterproofing Requirements**

Typical Properties	ASTM Method	Value
Solids by Weight	ASTM D1644	60% min
Elongation	ASTM D412	300% min
Water Vapor Permeance	ASTM E96	0.1 perms max
Hardness	ASTM C661	60 max

511.2.12 Swellable Hydrophilic Waterstop

Swellable hydrophilic waterstop shall meet the requirements of ASTM D-71, ASTM D-6, and ASTM D-217. The following properties will apply:

1. Specific gravity — ASTM D71: 1.35;
2. Hydrocarbon content — ASTM D4: 47%;
3. Volatile matter — ASTM D6: one percent (1%);
4. Penetration cone in accordance with ASTM D217 at 77 degrees F (25 degrees C): 40 mm; and
5. Service temperature range: -30 to 180 degrees F (-34 to 82 degrees C).

511.3 CONSTRUCTION REQUIREMENTS

511.3.1 Concrete Placement

Concrete shall be placed and tested for compliance with the Project Specifications in accordance with Section 510, "Portland Cement Concrete."

511.3.2 Temporary Works and Falsework

511.3.2.1 Temporary Works

The Contractor shall perform temporary Works in accordance with the current edition of the AASHTO Guide Design Specification for Bridge Temporary Works and the AASHTO Construction Handbook for Bridge Temporary Works.

Although the document contains "Guide Design Specifications," the Contractor shall consider them to have the same importance and standing as a code or a Specification. If the content of the collaboration documents appears permissive with words such as "should," "could," "may," etc., the Contractor shall consider the content to be a requirement unless otherwise approved by the State Bridge Engineer.

In the event of a conflict between a referenced code and this Specification, this Specification will take precedence.

511.3.2.2 Falsework and Falsework Foundations

The Contractor shall construct Structure in accordance with Section 511, "Concrete Structures," and Section 512, "Superstructure Concrete", as applicable.

The Contractor shall design, construct, and maintain falsework and falsework foundation to provide the required strength and rigidity, and to support loads without settlement. The Contractor shall have a professional Engineer licensed in the State of New Mexico design the falsework and its foundation. The design of the falsework and foundation will be required if one (1) or more of the following conditions apply:

1. If the height of the Structure is greater than ten (10) ft (excluding concrete Culverts with bottom slabs);
2. Where the supported span is greater than 15 ft; or
3. Where traffic, other than workmen involved in constructing the Structure, will travel under the falsework.

The Contractor shall place the falsework on an adequate foundation. The maximum foundation bearing pressure is 2,000 pounds per square foot unless a Geotechnical investigation indicates a higher value can be used. The Contractor shall provide methods for measuring settlement or movement of falsework and forms under load. If falsework shows settlement greater than 3/8 inch at the vertical supports, the Contractor shall stop the Work and correct the settlement or movement.

If pilings are used for falsework, the Contractor shall pull or cut off falsework pilings. The Contractor shall ensure the cut-off elevations are one (1) ft below the low water level, natural ground, or bottom of proposed channel.

If required, the Contractor shall submit Plans for falsework to the State Bridge Engineer for approval. The Contractor shall submit proposed changes to existing Structures required for maintenance of traffic to the Project Manager for approval. 30 Days shall be allowed for the initial review. 15 additional Days shall be allowed for each resubmittal.

511.3.3 Form Construction

The Contractor shall make forms mortar tight and sufficiently rigid to prevent deformation due to the pressure of the concrete and other loads incidental to the construction operations, including vibration. The Contractor shall construct and maintain forms to prevent the joints from opening. The Contractor shall construct and maintain forms used on surfaces in public view such that the finished concrete surface will be smooth and of uniform color and texture.

The Contractor shall remove loose dirt, laitance, and miscellaneous debris from the bottom of the forms before placing concrete.

The Contractor shall fillet forms and chamfer them 3/4 inch, unless required otherwise in the Contract, and give them a bevel or draft for easy removal of projections such as girders and copings.

511.3.3.1 Form Lumber

The Contractor shall use lumber that is planed on at least one (1) side and the two (2) edges for exposed concrete surfaces. The Contractor shall place the planed face so that it will be the formed surface for the concrete being placed.

511.3.3.2 Metal Ties

The Contractor shall construct metal ties and anchorages within the forms to permit the removal of a portion of the tie connections without damaging the concrete, and provide at least 1/2 inch depth of cover from the concrete surface.

511.3.3.3 Surface Treatment of Forms

The Contractor shall ensure that forms have been properly wetted before placing concrete.

The Contractor shall use form release agents at their discretion before placing reinforcing steel. The Contractor shall not use form release agents that adhere to or discolor the concrete.

511.3.3.4 Metal Forms

The Contractor shall provide metal forms thick enough to prevent bending and maintain their shape. The Contractor shall use countersunk bolts and rivet heads. The Contractor shall use clamps, pins, and other connecting devices designed to hold forms rigidly together and for removal without damaging the concrete. The Contractor shall use metal forms that have a smooth surface and line up properly.

The Contractor may use metal forms that remain part of the Structure in accordance with the Contract or as approved by the State Bridge Engineer. The Contractor shall use permanent steel Bridge deck forms in accordance with Section 512.3.4.1, "Permanent Steel Deck Forms."

511.3.3.5 Reuse of Forms

The Contractor shall continuously maintain the shape, strength, rigidity, water tightness, and surface smoothness of reused forms. The Contractor shall resize warped or bulged lumber before reusing it.

511.3.4 Temperature and Weather Limitations

The Contractor shall keep the concrete mixture temperature between 50 °F to 90 °F at the time of placement.

511.3.4.1 Cold Weather Concrete

The Contractor shall place cold weather concrete in accordance with ACI 306, "*Cold Weather Concreting*."

If air temperatures are likely to fall below 40 °F during the placement or curing periods, the Contractor shall submit a cold weather concreting and curing plan to the Project Manager for approval by the State Concrete Engineer before concrete placement. The Contractor shall allow 14 Days for review. The Contractor shall ensure that the Plan details the methods and Equipment to maintain the required concrete temperatures over the entire concrete pour area.

Information submitted will include, but not be limited to:

1. Whether or not outside heating sources will be used (and how the exhaust will be vented away from the fresh concrete);
2. Whether or not the rate of surface evaporation is expected to exceed the limitations detailed in Section 511.3.4.3, "Rate of Evaporation Limitations" and measures to be taken;
3. What the target mix temperature will be;
4. How the concrete will be protected from the ambient conditions;
5. Curing methods to be used during and following the protection period;

6. How soon after the placement the protection from the ambient conditions will be implemented;
7. Who will be responsible for insuring that the proper protection from the environment is properly implemented;
8. How the actual temperature of the concrete will be monitored;
 - a. How often will this be checked;
 - b. Who will do the checking;
9. What actions will be taken if the temperatures fall below the target points;
10. Who will be responsible for taking the necessary actions; and
11. Who the contact will be if Department Personnel need to transmit notices or information about the cold weather conditions.

Review and Acceptance of the Cold Weather Concreting and Curing Plan shall not relieve the Contractor from its obligation to perform the Work and provide Materials in strict conformance with the Contract.

The Contractor shall not place concrete directly onto any surface that is less than 40 °F unless otherwise approved by the Project Manager. The Contractor shall not place concrete on frozen ground.

If placing concrete at or below air temperatures of 35 °F, the Contractor shall provide suitable enclosures and heating devices. The Contractor shall vent exhaust from combustion type heating devices outside the placing area so that the exhaust fumes cannot come in contact with the freshly placed concrete.

The Contractor shall ensure the concrete surface temperatures never fall below 45 °F during placement and the first three (3) Days after placing. The Contractor shall not let the surface temperature fall below 40 °F during the next four (4) Days after the initial three (3) Day curing period, or until the in-place strength determined by the *Maturity Method*, in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements" indicates that 75% of the design strength is achieved.

The Contractor shall monitor the minimum concrete temperatures at various locations including edges and corners of slabs or other Structures, and check immediately before placing insulating Material over the concrete.

If heating the aggregates or water, the Contractor shall use heating methods and Equipment that can heat the Material uniformly. The Contractor shall not heat the Materials to more than 110 °F. During the heating or mixing process, the Contractor shall not add cement to water and aggregate combinations that are hotter than 90 °F.

511.3.4.2 Hot Weather Concrete

The Contractor shall place hot weather concrete in accordance with ACI 305, "*Hot Weather Concreting*."

Hot weather is any combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration or otherwise causing detrimental results: high ambient temperature; high concrete temperature; low relative humidity; wind speed; or solar radiation.

The Contractor shall estimate the rate of evaporation at the surface of the concrete per

Section 511.3.4.3, "Rate of Evaporation Limitations." If the rate of evaporation is anticipated to be greater than 0.2 lb per sq ft per hour, the Contractor shall submit a hot weather concreting and curing Plan to the Project Manager for approval by the State Concrete Engineer before concrete placement. The Contractor shall allow 14 Days for review.

The Contractor's Hot Weather Concreting and Curing Plan shall include measures that shall be taken by the Contractor at their expense and maintained to the satisfaction of the Project Manager to reduce the rate of evaporation during initial cure to within the specified rate. The methods can include but not be limited to following:

1. Erect windbreaks to reduce the wind velocity over the concrete surface;
2. Place concrete during nighttime or early morning hours;
3. Use cool aggregate and mixing water to lower the fresh concrete temperature;
4. Increase the relative humidity at the site with a fog spray; and/or
5. Apply a liquid-applied evaporation reducer.

Review and Acceptance of the Hot Weather Concreting and Curing Plan shall not relieve the Contractor from its obligation to perform the Work and provide Materials in strict conformance with the Contract.

511.3.4.3 Rate of Evaporation Limitations

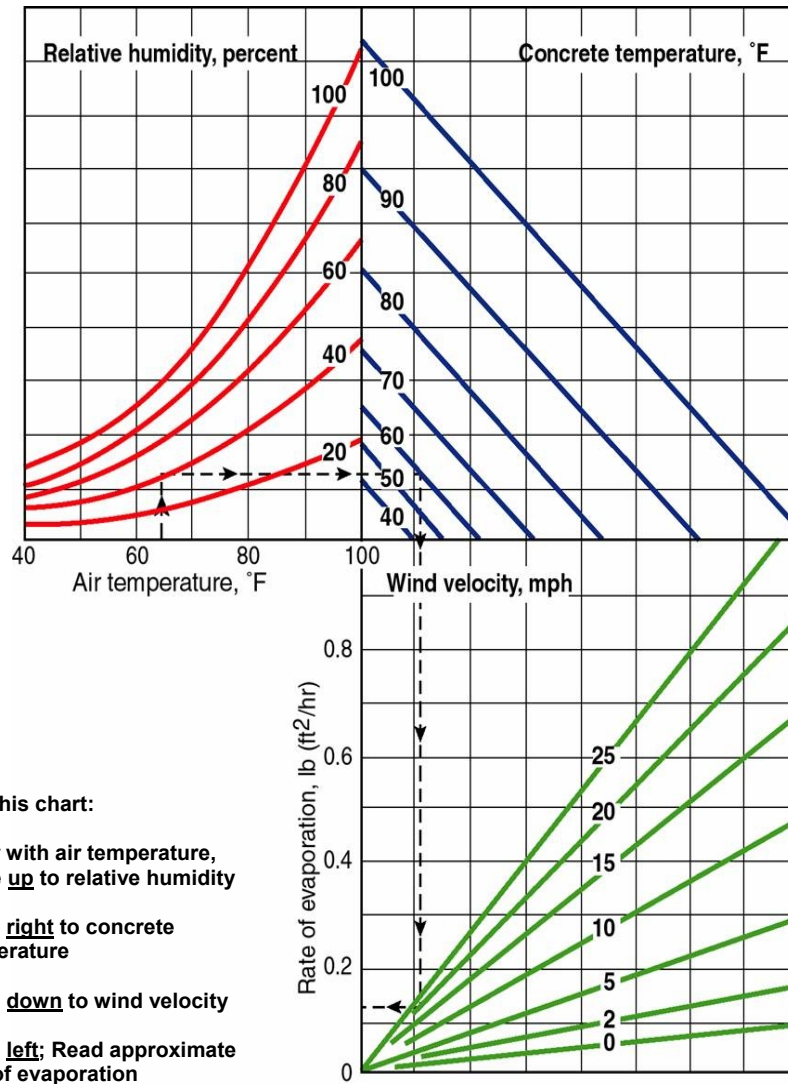
The "Rate of Evaporation Limitations" are detailed in ACI 305 – Hot Weather Concrete. These procedures lessen the potential of plastic-shrinkage cracking in concrete. The "Rate of Evaporation Limitations" apply to Bridge decks, approach slabs, CBC (top and bottom slabs), slipped formed concrete Structures, all PCCP and structural shotcrete. ACI 308 – Guide to Curing Concrete emphasizes that the rate of evaporation limitations can be exceeded in both cold and hot weather and must be addressed in both conditions.

The Contractor shall determine the anticipated rate of evaporation of surface moisture from the concrete by utilizing Figure 511.3.4.3:1, "Surface Evaporation from Concrete." The Contractor shall not place concrete if the anticipated rate of evaporation exceeds 0.20 lb per square foot per hour at the site over any ten (10) minute period, unless measures are taken to prevent excessive moisture loss from the surface of the concrete during initial curing. See Section 511.3.4.2, "Hot Weather Concrete" for Acceptable measures. These measures must be detailed in the Cold Weather Concrete Plan per Section 511.3.4.1, "Cold Weather Concrete" or the Hot Weather Concrete Plan per Section 511.3.4.2, "Hot Weather Concrete."

During the concrete placement, the wind speed, relative humidity and ambient air temperature shall be collected via a computerized weather station that shall be provided and retained by the Contractor. The weather station shall be an automated system that does not require any human support or effort after its initial set-up. The Contractor shall record readings at minimum five (5) minute intervals until the final curing system has been physically applied. Copies of these readings shall be submitted to the Project Manager within 24 hours of the placement. Measurements to determine the Surface Evaporation from the Concrete shall be taken at a height of approximately five (5) feet above the deck for relative humidity and ambient air temperature, and between a height of 20 inches and five (5) feet for wind speed.

For concrete placements that are smaller than ten (10) cubic yards, a handheld anemometer may be used in lieu of a weather station. The handheld anemometer shall be capable of measuring wind speed, humidity and air temperature; and shall be supplied and retained by the Contractor.

Figure 511.3.4.3:1
Surface Evaporation from Concrete (reference ACI 305)



To use this chart:

1. Enter with air temperature, move up to relative humidity
2. Move right to concrete temperature
3. Move down to wind velocity
4. Move left; Read approximate rate of evaporation

511.3.4.3.1 Wind Break

If a wind break is used, the wind break shall be a minimum height of eight (8) ft - zero (0) inches protecting the Bridge deck, approach slabs, sleeper footings and/or transition slabs (if applicable). All areas of the freshly placed concrete must be protected by the wind break. The nature and type of windbreak to be used shall be approved by the Project Manager prior to placement of any Superstructure concrete.

511.3.4.3.2 Fogging System

If a fogging system is used, a water fog shall be continuously applied over the surface of the freshly placed concrete in such a manner that the entire surface is kept at a relative humidity of 90% or greater and the surface of concrete is kept at an evaporation potential of 0.15 pound/square foot/hour or less, as determined from Figure 511.3.4.3:1, "Surface Evaporation from Concrete." The evaporation potential shall be determined prior to fogging and outside the wind protection, and continuously monitored with evaporation potential measurements taken and recorded at least once every five (5) min throughout the entire placement, and continuing until the concrete curing system has been completely installed. If a wind break and/or fogging are being used, the Contractor shall obtain these readings from the protected area at a height of approximately five (5) feet above the protected concrete.

The area to be fogged shall be the entire area of the freshly placed concrete, which has not had the final finish applied. This fog shall be delivered through a network of nozzles, which are properly spaced to provide a uniform fog at the surface of the concrete. The nozzles used shall be of the type, which atomizes the water so that there are no visually discernible droplets of water. The area of coverage from each nozzle shall overlap all adjacent nozzle coverage by at least one (1) ft. It shall be demonstrated prior to the placement of the concrete that the intended system is capable of delivering the required fogging environment for at least twice the anticipated required time. The Contractor shall not finish or otherwise mix any of the fogging water into the fresh concrete.

The intended system must be properly field tested, and approved by the State Materials Bureau before being used on any Superstructure concrete. Fogging shall continue until the surface is treated with an approved curing method.

511.3.4.3.3 Liquid Applied Evaporation Reducers

If a liquid-applied evaporation reducer is used, it shall be selected from the Departments Approved Products list and must be applied in strict accordance with manufacturer's application instructions.

Liquid applied evaporation reducers are not curing compounds and are not finishing aids. Liquid applied evaporation reducers are to be used to reduce surface evaporation during the initial cure of concrete. Initial cure of concrete typically occurs up to and including bull-floating. Multiple applications of liquid applied evaporation reducer may be required, reference manufacturer's application instructions.

Upon commencing surface finishing (beyond bull-floating), further application of liquid evaporation reducers shall not be allowed (liquid evaporation reducers cannot be used as finishing-aids). The Contractor shall cure concrete after surface finishing in accordance with Section 511.3.9, "Curing."

511.3.5 Concrete Placement

Concrete shall be placed and tested for compliance with the Project Specifications in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall not place concrete until the Project Manager approves the reinforcing steel and forms. The Contractor shall ensure that forms are clean and free of rust, grease, and other Deleterious Material immediately before placing the concrete. The Contractor shall remove wooden form spacers immediately before placing concrete in that area.

The Contractor shall vibrate the concrete during placement to force the coarse aggregate from external surfaces and to bring mortar against the forms to produce a smooth finish significantly free of water, air pockets, and honeycombs.

The Contractor shall place concrete in girders, walls, and other similar Structures in horizontal layers. The Contractor shall ensure that the concrete is not too thick for the vibrator to consolidate and merge it with the previous layer. The Contractor shall not pour concrete layers deeper than two (2) ft.

The Contractor shall not place concrete faster than the rate used for the design of the forms. The Contractor shall adjust the rate for the temperature of the concrete being placed.

511.3.5.1 Chutes and Troughs

The Contractor shall avoid segregation of the Materials and the displacement of the reinforcement when placing the concrete. The Contractor shall use metal or metal-lined open troughs and chutes; the Contractor shall not use aluminum. All tools used for the moving and/or spreading of the concrete shall be square pointed tools. The Contractor shall not use round nose shovels and spreading tools.

Where the Contract requires steep slopes, the Contractor shall equip the chutes with baffle boards or use short lengths that reverse the direction of movement.

The Contractor shall keep chutes, troughs, and pipes clean and free of hardened concrete by thoroughly flushing with water after each pour. The Contractor shall discharge the water used for flushing away from the placed concrete.

The Contractor shall not allow concrete to free fall for more than three (3) ft. For CBC walls and retaining walls that are less than or equal to ten (10) inches thick, maximum free fall heights shall not apply. For CBC walls and retaining walls greater than ten (10) inch thick, concrete may have a free fall of less than nine (9) ft.

The Contractor shall fill each part of the form by placing the concrete as close to the final position as possible. The Contractor shall vibrate the concrete during placement to force the coarse aggregate back from the forms and around the reinforcement without displacing the bars. After the concrete's initial set, the Contractor shall not jar the forms or place strain on the ends of projecting reinforcement.

511.3.5.2 Concrete Pumping

If placing concrete by pumping, the Contractor shall install pumping Equipment so that vibrations resulting from the operation do not damage the concrete being placed. The Contractor shall obtain Project Manager approval before using concrete pumping Equipment.

Before placing the concrete, the Contractor shall clean the Equipment thoroughly. The Contractor shall operate the Equipment so that it pumps a continuous flow of concrete without air pockets and without an appreciable loss of slump or entrained air.

The Contractor shall control the loss of entrained air by one (1) or more of the following methods:

1. Tie the end of the pump hose so that the discharge end is pointing upward, forming a "J" at the end of the hose;
2. Install a series of four (4) consecutive elbows to form a 360° loop;

3. Reduce the diameter of the end of the pump line; or
4. Limit the enclosed angle of the boom arms to an angle of 135° or more.

The Contractor shall make sure that the discharge of the concrete from the pump is as close as possible to the bottom of the structure being placed, but in no case shall it be allowed to drop a distance greater than four (4) feet with the exception of CBC walls where the walls equal to or less than ten (10) inch thick, concrete may have a free fall of less than nine (9) ft.

The Contractor shall not use aluminum pipe. The Contractor shall not add water to the concrete during pumping. If water is added at the pump hopper to clear a clogged pump, the Contractor shall dispose of the concrete in the hopper and the line.

511.3.5.3 Conveyers and Belts

The Contractor may use conveyor belts to transport the concrete from the point of delivery to the point of placement. If using multiple belts, the Contractor shall ensure that the drop from one (1) belt to the next is no greater than 18 inches. At the end of the last belt, the Contractor shall not allow the concrete to free-fall more than four (4) ft. The Contractor shall ensure that the concrete coming off the end of any belt is not being segregated. If segregation occurs, the Contractor shall slow down the speed of the belt until segregation no longer occurs.

511.3.5.4 Placing Concrete Under Water

If placing concrete under water, the Contractor shall submit a mix design and procedure plan to the Project Manager. The Project Manager may require up to 30 Days to approve them. The Contractor shall allow time in the schedule to accommodate this approval process.

511.3.5.5 Vibrating/Consolidation

Unless otherwise directed by the Project Manager, and excluding drilled shafts, the Contractor shall consolidate concrete with suitable mechanical vibrators operating within the concrete. During concrete placement, the Contractor shall keep enough personnel, vibrators, and other tools available to assure adequate consolidation. If necessary, the Contractor shall supplement vibrating with hand spading with suitable tools to assure proper consolidation. If using vibrators, the Contractor shall use procedures in accordance with ACI 309 – Consolidation of Concrete.

The Contractor shall not use a "jitterbug" or any other flat tool that could cause concrete segregation.

The Contractor shall use vibrators that have each been certified within the last 90 Days to provide 8,500 to 12,500 Vpm.

The Contractor shall operate vibrators to consolidate the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The Contractor shall not use vibrators to make concrete flow or run. The Contractor shall vibrate long enough to accomplish consolidation, but do not vibrate so long to cause segregation or air bubbles. The Contractor shall insert the vibrators vertically into the concrete, and immediately withdraw upward along the same line with the opposite motion. The Contractor shall not drag the vibrator horizontally across the placing area.

When operating vibrators, the Contractor shall avoid contact with reinforcing bars, particularly epoxy coated reinforcing bars or bars that extend into concrete that has taken an

initial set. If vibrating concrete in areas reinforced with epoxy-coated bars, the Contractor shall cover the vibrators with nonmetallic sleeves to prevent damage to the epoxy coating.

511.3.5.6 Sequence of Placement and Application of Load

The Contractor shall not place superimposed loads on or against load carrying members, floor slabs, or retaining walls until the concrete reaches 75% of specified design compressive strength but no less than 2,500 psi, determined in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements." Concrete Box Culverts and CBC wingwalls shall not be backfilled until specified design compressive strength has been achieved.

The Contractor shall submit a concrete placement schedule to the Project Manager upon request. The Contractor shall plan and schedule concrete placement to prevent damage to previously placed concrete or to the curing or protection systems of previously placed concrete.

The following applies to concrete placement scheduling:

1. The Contractor may erect reinforcement and formwork for walls, columns, and pier caps 24 h after placement of footings or floor slab concrete. Unless otherwise provided, the Contractor may place concrete columns, walls, and pier caps, 48 h after placement of footing or floor slab concrete;
2. The Contractor shall not set beams or girders, or place Superstructure concrete until Substructure forms have been stripped sufficiently to determine the quality of the concrete;
3. The Contractor shall not place the load of the Superstructure on the Substructure until the Substructure concrete has been in place for at least 14 Days or until in-place strength measured by the Maturity Method indicates that the concrete has attained 75% of the design strength;
4. The Contractor shall ensure that the concrete has achieved sufficient strength as determined by the Maturity Method in accordance with the form design before placing concrete for integral horizontal members, such as pier caps or top slabs;
5. The Contractor shall place the vertical members at least seven (7) Days before mounting friction collars or falsework brackets that will support the weight of horizontal members. The Contractor shall ensure that the vertical members have attained the specified strength before applying loads, unless the Department approves otherwise;
6. The Contractor shall limit monolithic casting of walls and deck slabs of concrete box Culverts to Culverts that are six (6) ft high or less. The Contractor shall construct box Culvert walls higher than six (6) ft in accordance with this subsection; and
7. If the concrete is not gaining strength as expected, the Assistant District Engineer of Construction may extend the waiting periods. The Contractor shall conduct construction operations in a manner that does not damage the previously placed concrete.

511.3.5.7 Supplementary Lighting

The Contractor shall not mix, place, or finish concrete when the natural light is insufficient without using an adequate artificial lighting system, approved by the Project Manager. The Contractor shall test the lighting system at least one (1) Day before placing the concrete to assure that the system will provide sufficient light, without shadows or dark areas for placing, testing and finishing concrete. The Contractor shall ensure that the lights do not create a hazard for traffic on adjacent Roadways or Detours.

511.3.6 Removal of Forms

The Contractor shall not remove the forms until the concrete is strong enough to avoid damage by removing the forms.

If in-place strength tests in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements," are not used to control field operations, the Contractor shall remove forms in accordance with Table 511.3.6:1, "Timetable for Removal of Forms," not counting those Days when the temperature is below 40 °F.

**Table 511.3.6:1
Timetable for Removal of Forms**

Structural component	Minimum time for removal
Bottom of beams	14 Days
Bridge decks ^a	seven (7) Days
Floor slabs	seven (7) Days
CBC Floors	seven (7) Days
CBC Top Slab	seven (7) Days
Walls	24 h
Columns	48 h
Sides of beams	24 h
All other parts	24 h

^aAdditional requirements of Section 512, "Superstructure Concrete," shall apply.

If one (1) of the test methods in Section 510.3.5.2, "In-Place Concrete Strength Measurements," is used to control the field operations, the Contractor may remove forms from the bottom of beams and floor slabs when the concrete reaches 75% of the design compressive strength.

511.3.7 Joints

The Contractor shall make construction joints in concrete Structures in accordance with the Plans, unless otherwise directed or approved by the Project Manager.

If the concrete placement is interrupted and additional construction joints are required, the Contractor shall place the additional joints in planes perpendicular to the principal lines of stress, and at points of minimum shear, as approved by the Project Manager.

511.3.7.1 Keyed Joints

The Contractor shall mechanically bond construction joints with keys formed by beveled strips embedded in the surface of the concrete. The Contractor shall make the keys from 1 3/8 inch to 1 1/2 inch deep. The Contractor shall place the keys centrally within the thickness of the joint. The Contractor shall ensure that the keys have a width that is one-third (1/3) of the depth of the smallest dimension of the joint. The keys do not need to exceed the clear distance between reinforcing mats, or be greater than eight (8) inches. The Contractor shall provide raised keys in accordance with the Plans.

511.3.7.2 Bonding New Concrete to Existing

If bonding new and existing concrete, the Contractor shall retighten the forms before

depositing new concrete on or against the hardened concrete. The Contractor shall roughen the surface of the hardened concrete without loosening the aggregate or damaging the concrete on the surface. The Contractor shall thoroughly clean the surface of foreign matter and laitance.

The Contractor shall utilize a bonding method at the interface between the hardened and fresh concrete. It is Acceptable to utilize an enriched mortar or a bonding agent. When using enriched mortar, the Contractor shall saturate the surface of the concrete and scrub the enriched mortar onto the entire surface with a nylon bristled brush. The Contractor shall place the new concrete before the enriched mortar reaches an initial set. If using a bonding agent, the Contractor shall follow the manufacturer's application instructions. The Contractor shall place the concrete continuously from joint to joint, and finish the face edges of exposed joints in accordance with the Plans.

511.3.7.3 Water Stops and Flashings

The Contractor shall provide and place water stops, and flashings per the Contract documents. The Contractor shall splice or solder water stops and flashings to form continuous watertight joints.

Swellable hydrophilic waterstop shall be installed with two (2) inch minimum concrete cover. Materials shall be installed per manufacturer's installation instructions.

511.3.7.4 Joint Sealing Materials

The Contractor shall install joint sealers in accordance with the manufacturer's recommendations, including surface preparation and the use of primers and backer-rod as required.

511.3.8 Miscellaneous Construction

511.3.8.1 Setting of Bearings

The Contractor shall ensure the surfaces on which metal masonry plates and elastomeric bearing pads will rest are flat and on level planes. If using elastomeric bearing pads, the Contractor shall finish the Bridge seats slightly high and grind to the correct elevation.

If it is necessary to adjust the elevation of a bearing upward, the Contractor shall make the adjustment by placing full size shim plates. If it is necessary to adjust the elevation of a bearing downward, the Contractor shall make the adjustment by diamond grinding to a level plane-bearing surface. The Contractor shall not use grout to level or adjust elevation.

If placing a bearing surface below the level of adjacent concrete, the Contractor shall ensure water drains away from the masonry plate or elastomeric bearing pad.

The Contractor shall finish sections of Bridge seats on abutments or piers on both sides of bearing assemblies to drain, with a slope of from 1/16 inch to 1/8 inch per foot. The Contractor shall correct depressions that retain water.

511.3.8.2 Waterproofing

If required in the Contract, the Contractor shall protect the backsides of abutment backwalls and wingwalls by waterproofing. The Contract shall define the vertical and horizontal limits of the waterproofing. The Material shall be installed in conformance with the manufacturer's application instructions.

511.3.9 Finishing

The Contractor shall perform finishing after removing forms in accordance with the Contract.

511.3.9.1 Exposed Surfaces

The Department considers "exposed surfaces" as surfaces that are not buried in the ground or permanently covered by the fill, or against which the fill is not permanently placed. However, the Department does not consider the inside surfaces of concrete box drainage Culverts and concrete box girders, and the bottom side of concrete Bridge decks as "exposed surfaces."

511.3.9.2 Class 1, Ordinary Surface Finish

The Contractor shall apply a Class 1 finish to exposed surfaces as a final finish or before a Class 2, Rubbed Surface Finish, or a Class 4, Special Surface Finish.

A Class 1 finish includes the removal of rods, bolts, or other form ties to at least 1/2 inch deep from the face of the concrete. The Contractor shall fill tie holes and honeycombs with mortar composed of one (1) part cement and two (2) parts sand; the Contractor shall use the same brand and type of cement as used in the concrete.

The Contractor shall remove objectionable fins, bulges, and projections by rubbing with carborundum bricks or by other methods approved by the Project Manager. If necessary, the Contractor shall clean the entire surface. The Contractor shall keep such surfaces in an Acceptable condition until Final Acceptance of the Work.

The Contractor shall apply a Class 1 finish to surfaces buried in the ground or permanently against the fill, except that form ties may be cut off even with the concrete surface, and fins, minor bulges, projections, stains, and discolorations do not need to be removed.

Unless specified otherwise in the Contract, the Contractor shall apply a Class 1 finish to the front faces of backwalls of abutments, the top surfaces of Bridge seats on piers and abutments, and concrete curtain walls between pier pilings.

The Contractor shall apply a Class 1 finish to the inside surfaces of concrete box drainage Culverts, except as noted in Section 511.3.8.3, "Class 2, Rubbed Surface Finish."

511.3.9.3 Class 2, Rubbed Surface Finish

The Contractor shall apply a Class 2 finish to concrete surfaces generally exposed to public view.

The Contract may specify a Class 4, Special Surface Finish with selected colors, for various components or parts of components. If the Contract specifies a Class 4, Special Surface Finish, the Contractor shall apply a Class 2 finish first, unless otherwise approved by the Project Manager.

A Class 2 finish consists of a Class 1 finish, then thoroughly wetting the surface and applying a mortar.

The Contractor shall apply a thin mortar, in accordance with Section 511.2.1.1, "Concrete

Surface Finishing Materials,” and rub it into holes and pockets in the surface of the concrete. The Contractor shall allow the mortar to remain until it has set sufficiently to prevent removal by subsequent rubbing operations. The Contractor shall rub the surface with a No. 25 to No. 30 carborundum brick, then, rub with burlap to remove excess mortar. If the completed rubbed surface does not look uniform, the Contractor shall make a final finish by wet rubbing with a No. 30 carborundum brick.

The Contractor shall apply Class 2 finish to the following:

1. Outside vertical surfaces of Bridge decks;
2. Outside surfaces of exterior girders, curb and rail posts seen in elevation view;
3. Curb tops, post tops, inside faces of curbs, and faces of hand rails;
4. Exposed surfaces of pier columns and caps;
5. Abutment wingwalls and Bridge seats one (1) ft below final grade;
6. Bridge rehabilitation Projects with existing slope paving;
7. Top surface of slope paving (tops of Bridge seats require only a Class 1 finish);
8. Exposed surfaces of barrier railings on Bridges or concrete box Culverts;
9. Exposed surfaces of miscellaneous concrete Structures extending above Shoulder line grade and inside walls of concrete underpass Structures;
10. Concrete box Culverts used for drainage, on the soffit and streamside faces of headwalls and wingwalls, and for six (6) inches down the back side of wingwalls; and
11. The interiors of sidewalls to one (1) ft back from the face of the Culvert at the tops of the sidewalls, and extending on a 45° line downward and inward.

511.3.9.4 Class 3, Float Finish

The Contractor shall apply a Class 3 finish to upper surfaces not formed, such as tops of walls, headwall, tops of slabs and bottom slabs of box Culverts, copings and Bridge seats, except tops of Bridge decks, Sidewalks, or curbs.

A Class 3 finish consists of placing an excess amount of concrete in the forms and striking off this excess concrete with a template, forcing off the coarse aggregate below the surface. After striking off the concrete, the Contractor shall thoroughly work the surface with a wooden, cork, or canvas float without adding water or cement. Before the final finish has set, the Contractor shall use a fine brush to remove surface film and to produce a fine grain, smooth, sanded texture.

511.3.9.5 Class 4, Special Surface Finish

When specified in the Contract documents, the Contractor shall apply a Class 4, Special Surface Finish. The Class 4, Special Surface Finish shall be applied in accordance with Specification Section 548, “Coating of Concrete.”

The Contractor shall apply the Class 4 finish over the Class 2 finish, unless directed otherwise by the Project Manager.

The Contractor shall apply the Class 4 finish consistent with the location requirements of Section 511.3.8.3, “Class 2, Rubbed Surface Finish.” If repairing existing Structures, apply a Class 4 finish to the entire surface of the repaired components.

511.3.10 Curing

The Contractor shall cure all concrete in accordance with ACI 308 – Guide to Curing Concrete. All concrete shall receive a minimum of seven (7) Days of curing treatment. The Contractor shall use curing methods in accordance with Table 511.3.10:1, "Curing of Concrete Structures," unless the Contract specifies otherwise.

If the Department allows the Contractor to choose the curing method, the Contractor shall obtain the approval of the Project Manager before beginning curing operations.

**Table 511.3.10:1
Curing of Concrete Structures**

Method designation	Curing method description
Method 1	Water curing
Method 2	Curing compound
Method 3	Form curing
Method 4	Combination of Method 1 and Method 2
Structure description	Curing methods
Top surfaces of:	
Bridge decks ^a	4
Approach slabs	4
Concrete curbs, gutters and Sidewalks	1 or 2
Pier caps, abutment Bridge seats	1 or 2
Wingwalls and parapet walls	1 or 2
All vertical concrete surfaces that begin in contact with form Materials, including but not limited to:	3
Barrier walls, barrier railing, wingwalls, parapet walls, abutments, box culverts, decks, slabs, curbs, gutters, sidewalks, construction joints	
Elevated horizontal surfaces on the underside of structural elements that begin in contact with temporary form Materials including but not limited to:	3
pier caps, girders, structural slabs	
Slip Formed Concrete elements including but not limited to:	2
Concrete wall barriers, curb, gutter	
All other concrete ^b	1, 2, or 3

^aSee Section 512.3.10.1, "Curing," for additional curing requirements for Bridge decks.

^bUnless the Contract specifies otherwise.

511.3.10.1 Method 1, Water Curing

The Contractor shall keep the concrete thoroughly and continuously wet and covered for at least seven (7) Days. The Contractor shall place and anchor covers, mats, and sheeting to ensure continuous contact with the concrete surfaces.

The Contractor shall cover concrete slabs as soon as possible with a double layer of clean, wet burlap or cotton mats, or other moisture retaining Material approved by the Project

Manager. The Contractor shall ensure that the moisture retaining Materials lay flat with no wrinkles and that adjacent strips of moisture retaining Materials overlap at least 12 inches. After installation, the Contractor shall soak the moisture retaining Material and add moisture as required to ensure that it is not allowed to become dry for the duration of the specified curing period. The Project Manager will determine the suitability of the moisture retaining Material for reuse, based on the cleanliness and absorptive ability of the Materials.

In addition to the moisture absorptive Material, the Contractor shall install plastic sheeting over the moisture absorptive Material. If the slabs are on grade, the Contractor shall extend the cover Materials at least twice the slab's thickness beyond the edges of the slab, and make sure that the entire exposed surface of the concrete is protected. If the slab is a Bridge deck, the Contractor shall place the cover Materials to fully protect exposed edges and unformed surfaces of the concrete.

The Contractor may temporarily remove the cover from surfaces that require a rubbed finish for finishing, but shall restore the cover as soon as possible.

511.3.10.2 Method 2, Curing Compound

Application of curing compound shall be in accordance with manufacturer's application recommendations.

For slabs, Bridge decks and other flatwork, the Contractor shall apply the curing compound to the fresh concrete as soon after finishing as allowed by the manufacturer.

The Contractor shall thoroughly mix the membrane forming curing compound per the manufacturer's recommendations.

The Contractor shall not apply the curing compound in rainy conditions. The Contractor shall adhere to the thermal limitations as specified by the manufacturer – typically, the product when stored should not be allowed to freeze and should not be applied when the air or concrete temperature is less than 40 degrees Fahrenheit.

The Contractor shall apply the curing compound under pressure with an atomizing-type spray nozzle. The Contractor shall uniformly cover the entire surface area at the rate recommended by the manufacturer or at a rate of at least one (1) gal per 175 ft² whichever rate is greater. The Contractor shall use spray Equipment with enough pressure to force the curing compound to leave the nozzle as a fine mist. If the nozzle becomes plugged, the Contractor shall immediately clear the nozzle before continuing the application. The Contractor shall not continue to spray curing compound through a nozzle that has become plugged or obstructed.

The Contractor shall apply the curing compound by first spraying back and forth in one (1) direction until a uniform covering has been achieved. Then, the Contractor shall spray back and forth in a direction perpendicular to the first application until a second, uniform covering has been achieved. The Contractor shall ensure that the entire curing surface has been uniformly covered with two (2) coatings of curing compound. The Contractor shall not apply the curing compound to exposed reinforcing steel.

The Contractor shall protect all surfaces covered with curing compound for seven (7) Days after application. The Contractor shall provide walkways and mats for workmen, Material, and Equipment.

The Contractor shall not use a curing compound that exhibits separation, segregation, or skimming.

The Contractor shall not apply curing compound to surfaces that will receive a Class 2 or Class 4 finish, unless the Contractor thoroughly cleans the surfaces per the recommendations of the manufacturer of the Class 2 or Class 4 finish product.

511.3.10.3 Method 3, Form Curing

The Contractor shall leave forms in place in accordance with Section 511.3.6, "Removal of Forms." The Contractor shall keep wood forms moist during the curing period and replenish the system with water to maintain a continuously moist condition. The Contractor shall cure exposed surfaces with Methods 1 or 2.

Form removal shall be in accordance with Section 511.3.6, "Removal of Forms." Should forms be removed prior to the specified seven (7) day curing period, the Contractor shall immediately resume curing by Method 2.

For Structures with formed surfaces that require the application of a finish per Section 511.3.8, "Finishing" such as barrier walls, barrier railings on Bridges, wingwalls, or parapets on Bridges or box Culverts, the Contractor shall remove the forms in accordance with Section 511.3.6, "Form Removal," finish the concrete in accordance with Section 511.3.8, "Finishing," and resume curing with Method 2 for the duration of the curing period. The Contractor shall not pause curing for more than two (2) hours.

511.3.10.4 Method 4, Combination of Curing Compound and Water Curing

The Contractor shall apply Method 2 curing compound as soon after finishing as is allowed by the manufacturer.

When the concrete is hard enough that placement loads and burlap or cotton mats can be applied without marring the concrete surface or deformation of structural elements, the Contractor shall apply Method 1 curing directly over the curing compound coated surface.

511.3.10.5 Equipment and Personnel Readiness

The Contractor shall show the Project Manager that curing Material and Equipment (including backup sprayers and mixers) are in working order, at least one (1) Day before concrete placement.

511.3.10.6 Temperature Requirements for Storage and Application

The Contractor shall store curing compounds in protected areas away from weather and extreme temperatures and per the manufacturer's recommendations. The Contractor shall dispose of compounds that have been frozen in storage. The Contractor shall apply curing compounds when the temperature of the compound is between 50 °F and 95 °F.

511.3.10.7 Penetrating Water Repellent Treatment Solution

The Contractor shall saturate the exposed surfaces of the following concrete Structures with a penetrating water repellent treatment in accordance with Section 532, "Penetrating Water Repellent Treatment" for:

1. Bridge wingwalls;
2. Front and side faces of abutment Bridge seats;
3. Front faces of abutments, backwalls and diaphragms;

4. Top surfaces of Bridge seats on piers and abutments;
5. Pier columns, stem walls and vertical surfaces of pier caps;
6. Top and vertical side surfaces of Bridge decks, except in the areas where using epoxy Bridge deck overlays;
7. Top surfaces of concrete approach slabs;
8. Concrete barrier railings;
9. Concrete wall barriers; and
10. Sidewalks, curbs and gutters on Structures.

The Contractor shall extend treatment to at least one (1) ft below the final groundline.

The Contractor shall not treat the underside of pier caps, or side and end surfaces of concrete approach slabs.

511.4 METHOD OF MEASUREMENT

The Department will measure all pay items using the dimensions shown in the Contract or approved modifications.

511.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Structural Concrete, Class _____</i>	Cubic Yard
<i>Structural Concrete, Class _____, _____ inch</i>	Square Yard
<i>Substructure Concrete, Class _____</i>	Cubic Yard

511.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Waterstops and flashings;
2. Waterproofing;
3. Premolded and preformed joint fillers;
4. Concrete required to fill overbreakage in excavation when footings or walls are cast against vertical or horizontal faces of excavation;
5. Installation of drains and weep holes;
6. Extruded polystyrene; and
7. Means and methods associated with placement of concrete in hot and cold weather conditions, including but not limited to wind break, fogging systems, and temporary heat.

SECTION 512: SUPERSTRUCTURE CONCRETE

512.1 DESCRIPTION

This Work consists of constructing concrete Bridge decks, reinforced-concrete box-girder Bridges; slab Bridges, slant-leg Bridges, truss Bridges, and other structural configurations requiring the use of Superstructure concrete, also referred to as Class AA or Class HPD (High Performance Deck) concrete.

Cast-in-place concrete placed in Bridges above the bearings will be Class HPD unless otherwise shown in the Contract.

Bridges with integral abutments shall have wingwalls, end diaphragms, and concrete above the bearings constructed of Class HPD concrete.

Approach slabs, transition slabs, integral pier and abutment caps, and Superstructure appurtenances shall be constructed with Class HPD concrete, unless otherwise shown in the Contract.

512.2 MATERIALS

The Contractor shall provide Class HPD concrete in accordance with Sections 509, "Portland Cement Concrete Mix Designs" and 510, "Portland Cement Concrete."

The Contractor shall provide steel reinforcing bars and epoxy-coated steel reinforcing bars in accordance with Section 540, "Steel Reinforcement."

512.3 CONSTRUCTION REQUIREMENTS

Requirements contained in Section 511, "Concrete Structures," will apply unless expressly modified in this Section.

512.3.1 Deck Placement Conference

The Project Manager will hold a Deck Placement Conference three (3) to seven (7) Days before the anticipated deck placement to review the specification requirements and discuss the Contractor's preparations.

The recommended agenda checklist is available from the Bridge Bureau.

512.3.2 Profile Survey of Girders

After placing girders and before setting screeds, the Contractor shall take a profile along each line of girders. If actual top of girder elevations differ significantly (more than a nominal haunch dimension) from those shown on the Plans such that excessive haunches or deficient slab thickness would result, the Contractor shall make appropriate adjustments as directed by the State Bridge Engineer.

512.3.3 Falsework

The Contractor shall design a lateral bracing system to support the deck overhang and to resist the entire torsional load from the deck overhang during construction. Design of lateral bracing system shall be in accordance with the AASHTO *Guide Design Specifications for Bridge Temporary Works*. In the event of a conflict between the referenced *Guide* and this specification, this specification will take precedence.

The screed rails supporting the concrete deck finishing machine shall be supported directly on the center of the bridge girders. The concrete deck overhangs shall be screeded and finished by hand.

The Contractor shall submit the Working Drawings for the lateral bracing system and the design calculations stamped by a NM licensed Professional Engineer with a minimum of five (5) years of structural design and construction experience. Review of the construction bracing by the Department does not relieve the Contractor of responsibility to provide the proper means and methods for successful construction. The lateral resistance of the steel intermediate diaphragms attached to the girders shall not be included in the Contractor's lateral bracing system design. The cost of the lateral bracing system and its design shall be incidental to the cost of the concrete.

The Contractor shall submit Working Drawings and design calculations for the proposed girder bracing system to the Project Manager for approval at least 21 Days before the anticipated placement date. The Contractor shall allow 14 Days for review of re-submitted Working Drawings.

Construction of the lateral bracing system shall be in accordance with the AASHTO *Construction Handbook for Bridge Temporary Works*. In the event of a conflict between the referenced *Handbook* and this specification, this specification will take precedence.

512.3.4 Forms

The Contractor shall use deck forms in accordance with Section 511.3.3, "Form Construction."

512.3.4.1 Permanent Steel Deck Forms

The Contractor shall provide Material and elements for the permanent steel deck form units that are fabricated from steel in accordance with ASTM A 653M (A653) Grade A-3. The Contractor shall provide a Class G 165 coating. The Contractor shall provide form sheets and form supports in accordance with the shop drawings; that are at least 22 gauge and 16 gauge thick, respectively.

The Contractor shall not use permanent steel forms in panels where longitudinal slab construction joints are located between stringers. The Contractor shall provide proper vibration of the concrete to ensure adequate consolidation of concrete.

512.3.4.1.1 Permanent Ventilated Steel Deck Form Design

The Contractor shall design permanent steel forms to support superimposed dead loads of the form, reinforcement, and plastic concrete, plus a live load of 50 pounds per square foot. The Contractor shall use steel ventilated at a minimum rate of 1/2 inch² per square foot.

The Department will not allow the following:

1. Unit working stresses to exceed the lesser of the following:
 - 1.1. 72.5% of the specified minimum yield strength of the Material, or
 - 1.2. 36,000 psi.
2. Maximum deflections under the weight of the plastic concrete, reinforcement, and form, to exceed the lesser of the following:
 - 2.1. 1/240 of the form span, or

- 2.2. 3/4 inch.
3. A load used to compute the deflection that is less than 120 lb per square foot.

The form span for design and deflection is the clear distance between the flanges of the supporting girders less two (2) inches, measured parallel to the form flutes.

The Contractor shall limit the increase in dead load due to the use of permanent steel deck forms to 15 lb per square foot. If the increase exceeds this limit, show that the additional load will not be detrimental; or strengthen the Structure to accommodate the extra load, at no additional cost to the Department.

The Contractor shall calculate physical design properties in accordance with the current American Iron and Steel Institute Specification for *Design of Cold-Formed Steel Structural Members*.

The Contractor shall design the permanent steel deck forms so that the deck slab laterally supports the steel girder or girder top flanges in compression, except where providing shear connectors.

The Contractor shall provide design calculations to the Project Manager for approval by the State Bridge Engineer 14 Days prior to ordering.

512.3.4.1.2 Permanent Steel Deck Form Installation

The Contractor shall not rest form sheets directly on the top of the stringer or floor beam flanges. The Contractor shall securely fasten sheets to form supports. The Contractor shall use sheets with a minimum bearing length of one (1) inch at each end. The Contractor shall place form supports in direct contact with the flange of stringers or support beams. The Contractor shall make attachments with welds, bolts, clips, or other approved means; the Contractor not weld to girder or beam flanges. All welding must be performed by a certified welder in accordance with the applicable documents and welder qualifications listed in Section 541.3, "Steel Structures; Construction Requirements."

The Contractor shall place bottom reinforcing bars with a minimum cover of one (1) inch. Except in cases where reinforcing bars are not parallel to form corrugations, the Contractor shall center the bars (approximately) in the bottom layer of the main reinforcement over the valleys of the forms when necessary to achieve the minimum concrete cover. The Contractor shall not allow the distance from the top of the slab to the bottom layer of main slab reinforcement to be less than the dimension shown in the Contract.

512.3.5 Placing of Reinforcing Bars

The Contractor shall firmly support reinforcing bars in deck slabs with approved devices spaced at intervals not exceeding 3.3 ft. The Contractor shall securely tie down reinforcing bar mats in Bridge decks to girders and forms to prevent upward movement during concrete placement.

The Contractor shall not allow the spacing between adjacent reinforcement bars to vary more than 1/2 inch from the dimensions shown in the Contract. The Contractor shall place and maintain reinforcement bars within 1/4 inch of the vertical dimensions shown in the Contract. The Contractor shall not allow the concrete cover over the top layers of reinforcement to be less than two (2) inches.

For continuous steel Bridges, the Contractor shall complete the forming and placing of

reinforcing steel and screed rail settings for the entire length of the Bridge before proceeding with any portion of the deck placement, unless otherwise authorized by the State Bridge Engineer.

512.3.6 Preparation for Placing Concrete

512.3.6.1 Support of Finishing Machines

The Contractor shall ensure finishing machines travel on steel rails. The Contractor shall provide pipe for rails with 2 3/8 inch outside diameter and 1 15/16 inch inside or heavier. The Contractor shall firmly support rails on adjustable steel supports. The Contractor shall securely fasten supports in place and do not space them more than 30 inches apart. The Department will not allow the Contractor to weld the supports to top flanges of steel girders or girders, or to the stirrups of concrete girders.

512.3.6.2 Setting of Screed Rails

The Contractor shall set the steel rails for placing and finishing Equipment to finish the deck in accordance with the Contract or as directed by the Project Manager. The Contractor shall make the accuracy of setting the rails consistent with the required tolerances for smoothness. The Contractor shall check elevations and straightness of the rails by survey, straight edging or string lining, and sight by eye.

If supporting the finishing machine over an outside girder, the Contractor shall check edge forms for the deck for vertical alignment and install in accordance with the Contract tolerances for smoothness. The Contractor shall provide rails that extend a sufficient distance beyond both ends of the scheduled length of placement to permit the finishing machine to reach all areas of the concrete placed and to permit off-deck parking of the machine out of the way of the hand finishers. The Contractor shall check the finishing machine setup for correct deck cross sections. The Contractor shall check blockouts for expansion joints for proper depths and widths of openings.

512.3.6.3 Finish Machine Trial Run

At least 24 h before placing concrete, the Contractor shall traverse the finish machine the length of the proposed placement or, if a continuous steel Bridge, for the full length of the Bridge.

The Contractor shall demonstrate that the following performance criteria are met during the trial run:

1. Use of required deck slab thickness, top of deck elevations, and the specified reinforcing bar cover; unless otherwise noted on the Plans, provide cover to the top of the top reinforcing bars of from 2 (two) inches to 2 7/16 inches. When checking the deck slab thickness, top of deck elevations, and cover, allow for deflections of supports resulting from the weight of the concrete;
2. Do not allow screed rails to deflect excessively;
3. The finishing machine is properly adjusted and in good working order; and
4. The finishing machine will properly track over the entire length of the proposed placement, particularly for decks that are curved, super-elevated, or that have a high skew.

512.3.6.4 Work Bridges

The Contractor shall provide one (1) or two (2) transverse Work Bridges for floating, straight edging, and curing operations. The Contractor shall provide Work Bridges that are structurally sound and do not deflect excessively. The Contractor shall test the Work Bridges in place before the deck placement to ensure proper adjustments of wheels, adequate clearances to safety railings, and compliance with other requirements.

512.3.7 Placing of Concrete

The Contractor shall place concrete by pumping or other approved means.

The Contractor shall place concrete close to the final position and to the full thickness of the slab. The Contractor shall place concrete far enough in front of the finishing machine to ensure proper striking off and finishing, generally a distance not greater than 12 ft.

Unless otherwise directed by the Project Manager, the Contractor shall consolidate concrete with suitable mechanical vibrators operating within the concrete. During concrete placement, the Contractor shall keep enough personnel, vibrators, and other tools available to assure adequate consolidation. If necessary, the Contractor shall supplement vibrating with hand spading with suitable tools to assure proper consolidation. If using vibrators, the Contractor shall use procedures in accordance with ACI 309.

The Contractor shall not use a "jitterbug" or any other flat tool that could cause concrete segregation.

The Contractor shall use approved vibrators that can transmit vibration at frequencies up to 10,000 Vpm. The Contractor shall provide vibrators that have each been certified within the last 90 Days to provide 8,000 to 10,000 Vpm.

The Contractor shall operate vibrators to consolidate the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The Contractor shall not use vibrators to make concrete flow or run. The Contractor shall vibrate long enough to accomplish consolidation, but do not vibrate so long to cause segregation or air bubbles. The Contractor shall insert the vibrators vertically into the concrete, and immediately withdraw upward along the same line with the opposite motion. The Contractor shall not drag the vibrator horizontally across the placing area.

When operating vibrators, the Contractor shall avoid contact with reinforcing bars, particularly epoxy coated reinforcing bars or bars that extend into concrete that has taken an initial set. If vibrating concrete in areas reinforced with epoxy-coated bars, the Contractor shall cover the vibrators with nonmetallic sleeves to prevent damage to the epoxy coating.

If hydraulic fluid, motor oil, dirt, or other Deleterious Material leaks or falls onto the deck, the Contractor shall remove contaminated concrete from the deck before proceeding.

The Contractor shall place concrete for abutment and/or pier diaphragms monolithically with Bridge deck, unless otherwise shown in the Plans.

512.3.7.1 Pumping of Concrete

Before placing concrete, the Contractor shall thoroughly clean the Equipment. The Contractor shall operate the pump to produce a continuous stream of concrete without air pockets and no appreciable loss of slump.

If placing concrete by pumping, the Contractor shall not add water at the concrete entrance hopper. If adding water at the pump hopper to clear a clogged pump, the Contractor

shall remove and dispose of concrete in the hopper and the line.

The Contractor shall obtain the Project Manager's approval of concrete pumping Equipment before use. The Contractor shall provide a backup placement system capable of completing concrete placement to a bulkhead in case of a pump failure. The Contractor shall provide bulkheads that are pre-cut and ready for installation.

The Contractor shall not use aluminum pipe as a conduit for concrete placement.

The Department will test concrete for Acceptance at the discharge end of the pump, and collect samples from concrete placed on the deck.

512.3.7.2 Delays in Deck Placement

The Contractor shall stop placement operations and correct, if one (1) of the following problems occur:

1. A deck-finishing machine fails;
2. Placement operations are not within the specification requirements; or
3. Placement operations are not achieving satisfactory results.

If the concrete placement is Delayed, the Contractor shall stop all other placement operations until the cause of the Delay is corrected.

If the Contractor fails to correct the problem within 45 min (or within 60 min if using a set retardant), the Contractor shall erect a bulkhead parallel to the finishing operations and as close as practical to the location that placement originally stopped. The Contractor shall finish concrete to the bulkhead and discontinue placement operations for the Day. Before deck placement, the Contractor shall cut the bulkhead to length and slot it for reinforcing bars.

For slab Bridges, the Contractor shall install the bulkhead as close to one (1) of a span's quarter points as possible.

If deck placement operations have been suspended and bulkheads installed, the Contractor shall not resume deck construction until after 12 h and after taking adequate corrective measures to ensure concrete mixing, placement, finishing, and curing are performed in accordance with the Contract, as approved by the Assistant District Engineer for Construction in consultation with the State Bridge Engineer.

512.3.7.3 Rate of Evaporation Limitations

The Contractor shall comply with Section 511.3.4.5, "Rate of Evaporation Limitations."

512.3.7.4 Rate of Progress

The Contractor shall provide a rate of progress of Bridge deck placement in accordance with the Contract. If the Contract does not define a rate, the rate of progress will be at least 30 ft per hour over the entire width of the deck, except for slab Bridges, for which the rate will be at least 20 ft per hour.

If the placement includes integral pier or abutment diaphragms, the Contractor shall not include the time required to place the diaphragms in the rate of placement calculations. The Contractor shall include Delays in the placement due to other causes in the calculation of the overall rate of pour.

The Department may reject decks placed at rates slower than specified.

The Project Manager may decrease the rate of placement by 25%, if the following conditions exist:

1. The rate of evaporation is less than 0.08 lb per square foot per hour;
2. The wind velocity on the deck is less than ten (10) mph; and
3. The Contractor is producing an Acceptable finish.

512.3.7.5 Concrete Placement in Girders

Unless otherwise approved by the Assistant District Engineer – Construction, the Contractor shall uniformly deposit concrete in girders the full length of the girder and bring up evenly in horizontal layers not exceeding two (2) ft in depth.

512.3.8 Temperature and Weather Limitations

512.3.8.1 Temperature Requirements

The Contractor shall comply with Section 511.3.4, "Temperature and Weather Limitations."

512.3.8.2 Change in Weather Conditions

The Contractor shall assume the risk of proceeding with deck placement during marginal weather. The Contractor shall repair or remove and replace concrete damaged due to changing weather conditions.

After placement operations have started, if weather conditions change causing evaporation rates to exceed those previously specified or if other adverse weather conditions arise, the Contractor shall immediately place an emergency bulkhead, finish concrete to the bulkhead, and discontinue placement operations for the Day.

The Contractor shall keep Materials available to cover and protect unfinished deck areas and completed deck areas ahead of and behind the finishing machine as the machine moves forward to the bulkhead.

512.3.9 Finishing

The Contractor shall ensure that the rideability, drainage, and surface texture characteristics of finished Bridge deck slabs meet the requirements specified.

The Contractor shall provide deck with smooth transitions at ends of Bridges and across expansion and construction joints. The Contractor shall provide deck that is free draining, with no depressions.

Unless otherwise specified in the Contract or approved in writing by the Assistant District Engineer for Construction, the Contractor shall operate finishing machines with the skew of the Structure. The Contractor shall float and broom the plastic concrete parallel to the finishing operation.

The Contractor shall provide a ten (10) foot long, lightweight, round-bottom, straightedge equipped with a long handle, as approved by the Project Manager.

The Contractor shall not add water to the surface of the concrete to assist finishing.

512.3.9.1 Finishing Machine

The Contractor shall finish Bridge deck slabs and approach slabs with approved power driven finishing machines, unless the use of such machines is impractical and the Assistant District Engineer – Construction provides a written waiver.

The Contractor shall use finishing machines with one (1) or more rotating rollers, augers, and vibratory pans providing from 2,500 Vpm to 4,000 Vpm.

512.3.9.2 Finishing of Slab Edges

If an exterior beam or girder supports a finishing machine, the Contractor may hand finish the deck slab between the exterior beam or girder and the edge of the deck slab.

512.3.9.3 Hand Finishing Plan Submittal

The Contractor may finish the concrete deck slabs by hand if the use of a finishing machine is not possible. The Contractor shall submit a hand-finishing plan to the Project Manager for approval before initiating placement operations. The plan will describe the screed arrangement and proposed methods of finishing.

512.3.9.4 Final Finishing Operations

Immediately following the initial finishing operations and while the concrete is still plastic, the Contractor shall test the slab surface for trueness in accordance with Section 512.3.10.2, "Acceptance Criteria," by using the straightedge as a float. The Contractor shall advance the straightedge longitudinally along the slab in successive stages not more than 1/2 the length of the straightedge.

The Contractor shall correct variations in the surface of the slab by striking off projections and filling depressions with freshly mixed concrete. The Contractor shall consolidate and refinish the corrected areas with a long handled float at least three (3) ft in width.

The Contractor may use small hand floats if approved by the Project Manager. The Contractor shall recheck the surface with a straightedge.

During the floating and straight-edging process, the Contractor shall check and ensure that the deck has the proper crown, slope, and grade. The Contractor shall construct deck surfaces in the vicinity of deck drains to slope gently toward the drains.

The Contractor may use a float three (3) ft or greater in width to seal the surface behind the finishing machine.

Final finishing operations will follow the trailing edge of the finishing machine closely, generally, at a distance of 13 ft or less. The Contractor shall not allow more than one (1) h to elapse between the time of placement of concrete on the deck and the completion of final finishing operations.

Unless otherwise specified in the Contract, the Contractor shall apply a broomed finish to the plastic concrete parallel to the finishing operation.

512.3.10 Final Operations

512.3.10.1 Curing

Unless otherwise specified in the Contract, the Contractor shall cure Bridge decks and approach slabs in accordance with Section 511.3.10, "Curing." The Contractor shall ensure forms supporting Bridge decks remain in place for at least seven (7) Days.

512.3.10.2 Acceptance Criteria

The Contractor shall test the smoothness of the completed Roadway surfaces of Bridge decks, approach slabs, and the adjoining 50 ft of approach pavement. After the concrete of Bridge decks, approach slabs, and pavement hardens, the Contractor shall check the entire surface areas with a ten (10) foot straightedge. The Contractor shall hold the straightedge in successive positions parallel to the centerline of the Roadway and in contact with the slab. The Contractor shall advance the straightedge longitudinally along the slab in successive stages no greater than half the length of the straightedge.

The Contractor shall provide a finished surface plane of Bridge decks and approach slabs that do not vary more than 3/16 inch, measured from the bottom of the straightedge. The Contractor shall provide a finished surface of concrete or asphalt approaches that does not vary more than 1/4 inch, measured from the bottom of the straightedge. The Contractor shall plainly mark variations that exceed the allowable values.

The Contractor shall ensure that vertical steps or discontinuities at the ends of Bridges and approach slabs do not exceed 3/16 inch. The Contractor shall place expansion joints below grade, from 1/16 inch to 3/16 inch. The Department will reject expansion joints installed at elevations above the Roadway grade.

The Contractor shall remove smaller discontinuities or high spots greater than 3/16 inch by rubbing with carborundum brick and water. The Contractor shall correct larger areas of deck requiring repair by use of power grinders or similar tools approved by the Project Manager. The Department will not allow the use of a bush hammer or similar tools to remove irregularities. When grinding, the Contractor shall not reduce the concrete cover over the reinforcing steel to less than 1 9/16 inch. If diamond grinding cannot satisfactorily correct portions of decks, the Contractor shall remove and replace them at no additional cost to the Department.

After rubbing and diamond grinding, the Contractor shall restore the curing system on the deck as necessary.

The Assistant District Engineer – Construction may direct the Contractor to remove and replace unacceptable areas under the following conditions, at no additional cost to the Department:

1. The finished deck surface is exceedingly rough;
2. Plastic shrinkage cracking or surface tearing is severe;
3. Serious damage due to any cause occurs over large areas of the deck placement;
or
4. Concrete cover over reinforcing steel is less than required minimum.

512.3.10.3 Grooving of Hardened Concrete

The Contractor shall straightedge and repair the Bridge deck before grooving. The Contractor shall groove the deck after the deck has reached 75% of the design strength.

512.3.10.3.1 Grooving Machine

The Contractor shall groove hardened concrete with diamond blades mounted on a multiblade arbor on a self-propelled machine built for grooving concrete pavements. The Contractor shall provide a grooving machine with the following:

1. A depth control device that detects variations in the concrete surface and adjusts the cutting head height to maintain the specified groove depth; and
2. A device to control alignment.

512.3.10.3.2 Groove Pattern

The Contractor shall groove the Bridge decks, approach slabs and transition slabs parallel to the centerline of the Roadway if Bridge decks abut concrete pavement that is to receive longitudinal grooving, or if specified in the Contract. Otherwise, the Contractor shall cut grooves perpendicular to the centerline of the Roadway.

The Contractor shall begin grooving 18 inches from the gutter line or face of rail and run in a continuous pattern to 18 inches from the opposite gutter line or face of rail. The Contractor may increase the 18 inch dimension on one (1) side of the deck to as much as 27 inches, if the clearance of the grooving machine does not allow a closer approach to the railing.

The Contractor shall provide grooves that begin and end within from two (2) inches to four (4) inches of expansion joints, contraction joints, and ends of the slab.

The Contractor shall lay out the grooving accurately before cutting begins. The Contractor shall provide grooves that are 0.125 inch \pm 0.02 inch wide and from 1/8 inch to 1/4 inch deep.

If using transverse grooving, the Contractor shall space grooves in a random pattern from 1/2 inch to 7/8 inch centers. If using longitudinal grooving, the Contractor shall space grooves from 5/8 inch to 7/8 inch centers.

512.3.10.3.3 Grooving Residue Removal

The Contractor shall continuously remove resulting slurry or residue immediately following grooving operations. The Contractor shall clean the lands and the grooves and leave the surface free of slurry residue and other Deleterious Material.

The Contractor shall remove grooving residue by flushing, vacuuming, or other methods approved by the Project Manager.

512.3.10.4 Penetrating Water Repellent

After finishing, repairing, and machine grooving, the Contractor shall apply a penetrating water repellent treatment to Bridge decks and approach slabs in accordance with Section 532, "Penetrating Water Repellent Treatment."

512.3.11 Superstructure Appurtenances

512.3.11.1 Construction Joints

The Contractor shall make construction joints smooth and true to line, and finish them with an edging tool with a radius of approximately 1/8 inch. If longitudinal construction joints are located off the crown, the Contractor shall provide a finish across the joint that is smooth

and of a slope to provide proper drainage of the deck.

512.3.11.2 Sealing of Construction Joints and Surface Cracks

After grooving and applying the penetrating water repellent, the Contractor shall fill and seal construction joints and cracks that are visible on a dry deck with a resin in accordance with Section 535, "Crack Sealing Using Low-Viscosity, Gravity-Fed Sealers."

The Contractor shall apply resin to joints and cracks that permit the flow of water through the deck thickness as recognized by leaching along the crack or joint lines when viewed from below the deck, as determined by the Project Manager.

512.3.11.3 Sidewalks, Curbs, and Raised Medians on Structures

The Contractor shall thoroughly tamp the concrete in Sidewalks, curbs, and raised Medians on Structures so that a layer of mortar approximately 1/8 inch remains on top of the coarse aggregate. The Contractor shall strike off the surface of the concrete with a strike board to a uniformly smooth surface and float it with an acceptable wood or cork float.

The Contractor shall test the surface of Sidewalks and raised Medians with a ten (10) foot straightedge and ensure the surface does not vary more than 1/4 inch from the bottom of the straightedge.

The Contractor shall give Sidewalks, curbs, and raised Medians a broomed surface finish. After finishing and curing, the Contractor shall give the Sidewalks, curbs, and raised Medians a penetrating water repellent treatment in accordance with Section 532, "Penetrating Water Repellent Treatment."

512.3.11.4 Opening of Bridge Deck and Approach Slabs to Traffic

If it is necessary to open a Roadway to traffic at the earliest possible moment, the Assistant District Engineer for Construction may allow traffic on a Bridge deck or on approach slabs after the seven (7) Day curing period and after cylinders that are field cured in the same environment as the slabs demonstrate the concrete reaches 90% of specified design strength in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurements."

The Department will allow traffic on the deck before the application of the penetrating water repellent treatment, however; the Contractor shall perform the specified surface preparation procedures before application.

The Contractor shall construct Bridge deck prior to approach and transition slabs; no exceptions. Approach and transition slabs shall be constructed to match grade and elevation of the adjoining Bridge deck as shown in the Project Plans or as directed by the State Bridge Engineer if adjustments are required to match the completed Bridge deck.

512.4 METHOD OF MEASUREMENT

The Department will measure Superstructure concrete using the dimensions shown in the Contract or approved modifications. The pay quantity will not be increased for any additional volume of concrete placed because of the use of metal stay-in-place forms.

512.5 BASIS OF PAYMENT

PAY ITEM	PAY UNIT
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Superstructure Concrete
High Performance Deck (HPD)

Cubic Yard
Cubic Yard

512.5.1 Work Included In Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. All corrective Work;
2. Machine grooving;
3. Construction joint and crack sealing;
4. Formwork and lateral bracing system; and
5. Penetrating Water Repellent Treatment.

SECTION 514: CONCRETE BARRIER RAILINGS FOR BRIDGES

514.1 DESCRIPTION

This Work consists of constructing concrete barrier railings for Bridges.

514.2 MATERIALS

The Contractor shall provide Material in accordance with the following requirements:

1. Class HPD concrete will be used for barrier railings concrete on Bridges in accordance with Section 509, "Portland Cement Concrete Mix Designs" and 510 "Portland Cement Concrete."
2. Reinforcing steel in accordance with Section 540, "Steel Reinforcement."

514.3 CONSTRUCTION REQUIREMENTS

514.3.1 General

The Contractor shall perform Work in accordance with Section 511, "Concrete Structures."

The Department will not allow welding to anchor bars and other barrier reinforcement.

514.3.2 Deck Preparation for Barrier Placement

The Contractor shall cure Bridge deck tops beneath barrier railings using the water curing method per Section 511.3.9 "Curing". Before placing the railings, the Contractor shall thoroughly clean dirt, oil, and other Deleterious Materials from the deck surface.

514.3.3 Barrier Placement and Placement Tolerances

The Contractor shall cast concrete barrier railings in place using removable forms. Slip forming of concrete barrier railings for Bridges will not be allowed.

For Bridges set on tangents, the Contractor shall set the forms and place the concrete so that a stringline placed along the top inside edge of the finished barrier shows no horizontal deviations from a straight line greater than 3/8 inch within 20 ft.

For Bridges set on curves, the Contractor shall ensure that the horizontal deviations from the horizontal curve do not exceed 3/4 inch within 20 ft.

The Contractor shall ensure that the overall vertical tolerance of the outside surface of the barrier railings is less than 3/8 inch within the full height.

The Contractor shall place concrete for barrier railings in accordance with Section 511.3.5 "Concrete Placement." However, the Contractor shall not allow the depth of layers for placing concrete in the barrier forms to exceed 18 inches.

514.3.4 Finishing

The Contractor shall perform finishing in accordance with Section 511.3.9, "Finishing."

514.3.5 Curing

The Contractor shall perform curing in accordance with Section 511.3.10, "Curing."

514.3.6 Final Treatment of Barrier Railing

After finishing and curing, the Contractor shall apply a penetrating water repellent treatment to the exposed surfaces of the barrier railings in accordance with Section 532, "Penetrating Water Repellent Treatment."

514.3.7 Drilling Holes

The Contractor shall provide holes for attaching thrie-beam or W-beam terminal connector plates to barrier railings. The Contractor shall place the holes for attachments at least six (6) inches away from joints or ends of barrier railing.

If the Contractor elects to core drill the holes, care shall be taken to place reinforcement such that it will not be compromised by the core drilling process. The Contractor shall not spall the concrete during the core drilling process. Damaged reinforcing and spalled concrete will be repaired under Section 533 "Concrete Structure Repair" at no cost to the Department.

If the Contractor elects to sleeve the holes, care shall be taken to place the sleeved holes per Contract. Should the holes deviate from Contract, the Contractor shall replace the connector plates at no additional cost or schedule impact to the Department.

514.4 METHOD OF MEASUREMENT

The Department will measure concrete barrier railings along the top of the barrier from end to end, including concrete transitions.

514.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Concrete Barrier Railings</i>	Linear Foot

514.5.1 Work Included In Payment

The following items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Reinforcing steel;
2. Holes for terminal connector plates;
3. Dowels and all embedded steel items; and
4. Penetrating water repellent treatment.

SECTION 515: REINFORCED CONCRETE FOR MINOR STRUCTURES

515.1 DESCRIPTION

This Work consists of providing reinforced concrete for minor Structures.

515.2 MATERIALS

The Contractor shall provide Class A concrete with a design compressive strength of at least 3,000 psi in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall provide Grade 40 or 60 reinforcing steel in accordance with Section 540, "Steel Reinforcement." The Department will allow field bending and cutting.

The Contractor shall thread pre-formed hookbolts for the entire depth of embedment, or make hookbolts using reinforcing bar stock.

The Contractor shall provide chemical adhesive for anchoring hookbolts in accordance with Section 522, "Chemical Adhesive Anchors."

515.3 CONSTRUCTION REQUIREMENTS

The Contractor shall construct reinforced concrete for minor Structures in accordance with Section 510, "Portland Cement Concrete," Section 511, "Concrete Structures," and Section 540, "Steel Reinforcement."

The Contractor shall construct collars to fit tightly for joining pipe-to-pipe or pipe-to-box Structures. The Contractor shall ensure concrete plugs at the ends of existing conduits or box openings fit tightly.

The Contractor shall provide bulkheads at the junction of different sized pipes and conduits to prevent leakage of fresh concrete and mortar into the conduit. The Contractor shall remove concrete or mortar that leaks into the conduit. If required to maintain smooth flow conditions within the conduit, the Contractor shall form fillets of fresh concrete to reduce turbulence at conduit junctions.

515.4 METHOD OF MEASUREMENT

The Department will measure reinforced concrete for minor Structures using the dimensions shown in the Contract or approved modifications.

515.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Reinforced Concrete for Minor Structures</i>	Cubic Yard

515.5.1 Work Included In Payment

The following items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Reinforcing steel.
2. Waterstops.
3. Dowels, anchor bolts and hookbolts.

4. Excavation.

SECTION 516: FLOWABLE FILL

516.1 DESCRIPTION

This Work consists of providing and placing flowable fill.

516.2 MATERIALS

516.2.1 General

Flowable fill is a flowable mixture of Portland cement, fly ash, aggregates, admixtures and water.

516.2.2 Mix Design

The State Materials Bureau is responsible for approving the mix design for flowable fill. Approval of a flowable fill mix design by the State Materials Bureau will be valid for a period of five (5) years unless revoked due to performance problems.

516.2.3 Cement

See Section 509, "Portland Cement Concrete Mix Designs."

516.2.4 Aggregate

The Contractor shall provide a uniform mixture of fine aggregate or coarse and fine aggregate. The Contractor shall provide coarse and fine aggregate with a gradation in accordance with Table 516.2.4:1, "Aggregate Mixture Gradation Requirements."

**Table 516.2.4:1
Aggregate Mixture Gradation Requirements**

Sieve size	% passing
One (1) inch	100
3/8 inch	95 – 100
No. 4	80 – 100
No. 8	60 – 95
No. 16	45 – 80
No. 30	25 – 60
No. 50	5 – 45
No. 100	5 – 35
No. 200	0 – 30

516.2.5 Water

The Contractor shall provide concrete mix water in accordance with Section 509, "Portland Cement Concrete Mix Designs."

516.2.6 Air-Entraining Admixture

The Contractor may use an air-entraining admixture to provide air entrainment no greater than 35% in the flowable fill.

516.2.7 Fly Ash

The Contractor shall provide approved Class F, Class C, or Class C/F blended fly ash in accordance with Section 509, "Portland Cement Concrete Mix Designs."

516.2.8 Water-Reducing Admixture

The Contractor may use a water-reducing admixture.

516.2.9 Proportioning and Physical Property Requirements in the Laboratory

The Contractor shall provide a flowable fill mix design in accordance with the following limits:

1. Cement, maximum 50 lbs/yd³.
2. Fly Ash, from 150 lbs/yd³ to 300 lbs/yd³.
3. Air Content, optional.
4. Slump, from eight (8) inch to 11 inch.
5. Water/cement ratio, proportioned by weight to produce a slump within the prescribed limits.
6. Consistent aggregate throughout the concrete mixture.
7. Compressive strength will not exceed 150 psi at 28 Days.
8. Cast the test specimens in four (4) inch × eight (8) inch test cylinders, perforated on the bottom with four (4) 1/4 inch diameter holes for free draining.
9. Keep the test cylinders in a moist environment, but do not cure in a curing tank.
10. Cast six (6) compressive strength test cylinders in the Laboratory. Test two (2) cylinders at seven (7) Days, two (2) at 28 Days, and two (2) at 56 Days.

516.3 CONSTRUCTION REQUIREMENTS

516.3.1 Batching, Mixing, and Transporting

The Contractor shall perform batching, mixing, and transporting in accordance with Section 510, "Portland Cement Concrete."

516.3.2 Testing Flowable Fill in the Field

The Contractor shall obtain the State Materials Bureau's approval of the flowable fill mix properties before using the mix in the field.

For field testing, the Contractor shall use a standard (15 lb) T-post fence driver to drive a #6 reinforcing bar with a flat end into the flowable fill Material 24 h after placement. The Contractor shall lift the driver until the bottom of the driver is even with a mark located six (6) inches below the top of the rebar, and then allow it to fall under its own weight. The Contractor shall remove and replace the flowable fill if fewer than six (6) blows or more than 25 blows are required to drive the rebar 12 inches into the fill. The Contractor shall not use compressive strength test cylinders for field-testing purposes.

516.3.3 Pre-Placement Requirements

Before placing flowable fill, the Contractor shall remove any loose or uncompacted soils from the area to be filled. The Contractor shall ensure that all areas in which soils or

construction Materials have sloughed off or collected are completely cleared. The Contractor shall not place flowable fill against loose or uncompacted surfaces/materials.

The Contractor shall ensure that all pipes or other embedded items which would otherwise float to the top of the flowable fill are adequately secured to prevent their floating out of position.

516.3.4 Placing

The Contractor shall place flowable fill uniformly to prevent voids in or segregation of the bedding and filling Material. The Contractor shall secure the Culvert or pipe from movement.

The Contractor shall place the flowable fill by direct discharge from a ready mix truck, pumping, or other method approved by the Project Manager. The Contractor shall place the flowable fill in layers no more than 12 ft high. The Contractor shall place the flowable fill in layers no more than four (4) ft high for areas that require forming. The Contractor shall not place the individual layers until flowable fill in a previously placed layer has been in place at least two (2) h.

The Contractor shall submit a written request and obtain written approval from the Assistant District Engineer – Construction before placing the flowable fill in a full depth layer.

The Contractor shall not place the flowable fill on frozen ground or while it is raining. The Contractor shall protect flowable fill from flooding for at least 24 h after placement.

If necessary, the Contractor may place flowable fill in standing water that is positioned to keep the outside water from contaminating or mixing with the flowable fill.

The Contractor shall not allow any embedded items to float or otherwise dislodge. The Contractor shall secure pipe to compensate for buoyancy.

The Contractor shall fill the areas between the walls of the existing CBC and an inserted CMP thoroughly.

The Contractor shall not disturb the flowable fill Material for at least 24 h after placement. The Contractor may reduce this 24-hour period, if the penetration resistance of the Material justifies, as tested in accordance with Section 516.3.2, "Testing Flowable Fill in the Field."

516.3.5 Application of Load

The Contractor may cover the flowable fill within 24 h after placement, if a person weighing at least 150 lb does not sink into the Material more than one (1) inch, if standing on a four (4) inch × four (4) inch wooden block.

516.3.6 Temperature and Weather Limitations

The Contractor shall not place flowable fill when the air temperature is lower than 35 °F. The Contractor may begin placement only when weather conditions are favorable and the air temperature is at least 35 °F and rising. If the air temperature at the time of placement is less than 40 °F, the Contractor shall place flowable fill that has a temperature of at least 50 °F.

516.4 METHOD OF MEASUREMENT

The Department will measure flowable fill using the dimensions shown in the Contract or as approved by the Project Manager. The Department will consider flowable fill used at the

Contractor's option to be Incidental to the associated Bid Item.

516.5 BASIS OF PAYMENT

PAY ITEM

Flowable Fill

PAY UNIT

Cubic Yard

516.5.1 Work Included In Payment

The following Work will be considered as included in the payment for the main item and will not be measured or paid for separately:

1. When called for in the Contract, or the Contractor proposes its use and is approved by the Project Manager, flowable fill can be used for backfill in Culvert installations; and
2. No measurement or payment will be made for Work and Materials associated with backfilling pipes with flowable fill. This will be included in the Contract unit price per linear foot of Culvert pipe.

SECTION 517: PRECAST CONCRETE STRUCTURES

517.1 DESCRIPTION

This Work consists of fabricating and installing precast, non-stressed components composed of PCC.

The Department defines a concrete Structure or component that is cast in a location that is not its final intended in-service location to be precast concrete.

The Department defines non-stressed components as precast concrete members that are not subject to pre-tensioning or post-tensioning.

517.2 MATERIALS

Unless otherwise specified, the Contractor shall use concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs."

The Contractor shall provide PCC for precast concrete components in accordance with Section 510, "Portland Cement Concrete," unless otherwise specified in this section.

517.2.1 Design and Acceptability Requirements

Before casting, the Contractor shall obtain the State Materials Bureau's approval of the concrete mix design. The Contractor may only make changes to the approved mix design in accordance with Section 509.2.8, "PCC Mixture Design and Approval."

517.2.2 Testing Requirements

The Contractor shall perform sampling and testing of coarse and fine aggregates for alkali-silica reactivity in accordance with Section 509.2.4, "Aggregate."

If specified in the Contract or directed by the Project Manager, the Contractor shall determine the required compressive strength in accordance with AASHTO T 22, at no additional cost to the Department. The Contractor shall make and cure, or obtain from the manufacturer four (4) inch × eight (8) inch compressive strength test cylinders in accordance with AASHTO T 23. If the Contractor places more than five (5) yd³ of concrete in a Day, the Contractor shall make at least three (3) cylinders from the placed concrete. If the Contractor places less than five (5) yd³ of concrete in a single Day, the Contractor shall cast at least three (3) cylinders from a random sample for each 20 yd³ of placed concrete from consecutive pours.

A compressive strength test is the average of two (2) or more compressive strength cylinder tests performed at the same age. The Department will determine Acceptance of the concrete in accordance with Section 510.3.5.1.1, "Individual Strength Test." The Contractor shall enter the actual batch weights used in each batch of concrete and the measured moisture contents for each of the aggregates contained within each batch into the Field Report Form provided to the Contractor/Supplier at the same time the approved mix was provided. Insure that all test results for compressive strength and fresh concrete properties, including slump, air content and unit weight, are also entered into the Field Report.

If compressive strength tests fail to comply with the Contract requirements, the Department will allow the manufacturer to perform in-place compressive strength testing on the members in question. The Department will evaluate these tests in accordance with Section 510.3.5.4, "Investigation of Low Strength Cylinder Test Results."

The Contractor shall allow Department personnel access to obtain test samples and to perform Independent Assurance testing at the Department's discretion.

517.2.3 Steel Products

517.2.3.1 Reinforcing Steel

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

517.2.3.2 Structural Steel

The Contractor shall provide Structural Steel items in accordance with Section 541, "Steel Structures."

517.3 CONSTRUCTION REQUIREMENTS

517.3.1 General

The Contractor shall manufacture precast components in one (1) of the following plants:

1. A Precast Concrete Institute (PCI), National Precast Concrete Association (NPCA) or American Concrete Pipe Association (ACPA) certified plant regularly engaged in design, fabrication and construction of precast concrete components, or
2. An on-site Project specific facility inspected and approved by the Project Manager.

517.3.2 Quality Control

The Contractor shall ensure that precast concrete manufacturing facilities have a current Quality Control Plan on record that describes the procedures in detail. The Plan shall include an organization chart of the overall casting operation, a list of responsible people and a detailed description of their job duties, and the telephone number of the responsible party for contact 24 h per Day during fabrication and placement of precast Structures.

The Contractor shall obtain all batch weights used for each Day's production directly from the computer generated production record for each batch, and record each batch weight on the same Field Report form as the test results referenced in Section 517.2.2, "Testing Requirements." Electronic copies of the report form for each Day's production will be kept available for review by the Department Precast Concrete Inspector upon request. In addition to the electronic copy, a printed copy of the summary page and all original computer generated production records will be kept on file for each Day's production. The Contractor shall make these copies available to the Precast Concrete Inspector upon his request. For a facility that has no computer or computerized capability, actual batch weights of each ingredient will be recorded before the load is discharged.

Any Precast items cast from concrete batches that cannot be verified or with non-complying test results or batch weights cannot be used on Department Projects, and will be disposed of at no cost to the Department.

The Contractor shall submit certificates of compliance for cement, reinforcing steel, anchor bolts, supplemental cementitious Materials and liquid admixtures.

517.3.3 Notice of Beginning Work

The Contractor shall give the Project Manager and the Precast Inspector adequate notice before starting Work in the plant as follows:

1. Plants in the State of New Mexico: seven (7) Calendar Days;
2. Plants in the Contiguous United States: 21 Calendar Days; and
3. Plants outside the Contiguous United States: 60 Calendar Days.

The Contractor shall not perform Work before the Project Manager and the Precast Inspector give written authorization for fabrication.

The Contractor shall request inspections at least three (3) Calendar Days in advance.

517.3.4 Approval of Plants and Equipment

The Contractor shall obtain approval of the Precast Inspector for plants and Equipment used in manufacturing precast concrete members before Work begins. The Precast Inspector may forbid the use of machinery, Equipment, or appurtenances that prove unacceptable. In the event that the Contractor fabricates Materials on site, the Project Manager shall then approve on site plants and Equipment.

517.3.5 Shop Drawings

The Contractor shall fabricate precast concrete Structures in accordance with the Department's *Standard Drawings*. For modified or Project specific precast concrete Structures, the Contractor shall submit shop drawings stamped by a professional Engineer licensed in the State of New Mexico to the State Bridge Engineer for review and Acceptance. The Contractor shall provide shop drawings that show sizes, shapes, dimensions, and concrete cover for the reinforcing steel and other items embedded in the concrete. The Contractor shall provide shop drawings in accordance with ACI Detailing Manual and Section 541.3.1, "Applicable Codes and Documents."

The Contractor shall allow 30 Days for review and Acceptance of the modified or Project specific drawings. The Contractor shall allow 14 Calendar Days for review and Acceptance of *Standard Drawings*. Any re-submittals will require an additional 14 Days for review.

517.3.5.1 Calculations

The Contractor shall submit design calculations to the State Bridge Engineer for modified or unique precast concrete Structures not previously reviewed and approved by the Department. The Contractor shall ensure that a professional Engineer licensed in the State of New Mexico performs and stamps the calculations. The Contractor shall submit the design and calculations at least 30 Calendar Days for review and Acceptance before the start of fabrication.

517.3.6 Precast Concrete Member Assembly

517.3.6.1 Beds and Forms

The Contractor shall use forms that are smooth, mortar tight, and capable of withstanding forces caused by placement and consolidation of concrete. The Contractor shall accurately fabricate and secure forms in position so that the precast member has true, smooth, and even surfaces. The Contractor shall provide support for casting beds on unyielding foundations. The Department will not allow internal bracing and holding devices in forms if they remain in the finished member.

The Contractor shall provide corners with a chamfer or radius in accordance with the Plans.

The Contractor shall check the grade and alignment of forms each time they are set, and maintain them during concrete placement.

The Contractor shall ensure forms are reasonably free of rust, grease, or other Deleterious Materials. The Contractor shall thoroughly clean beds and forms after each use and before each casting operation. The Contractor shall not allow coatings used for release of members to build up. The Contractor shall maintain beds and forms to produce an Acceptable product.

The Contractor shall construct the forms to facilitate removal without damage to the concrete. The Contractor shall use care in removing forms to not deface or damage the member. The Contractor shall not use methods of removal that cause overstressing of the concrete.

517.3.6.2 Forms for Internal Voids

If constructing forms for internal voids, the Contractor shall use an approved watertight Material that is resistant to breakage and deformation during concrete placement. The Contractor shall provide stay-in-place internal forms that are as light in weight as practical. The Contractor shall securely anchor internal forms in position to prevent flotation or displacement during concrete placement.

The Contractor shall vent and drain stay-in-place void forms through the base of the member. The Contractor shall seal splices and ends of stay-in-place void forms to prevent concrete from entering.

The Contractor shall manufacture internal voids shaped by moving mandrels in accordance with the same dimensional tolerances as formed voids. The timing and rate of mandrel movement will preclude fallout of inner surfaces, tensile cracks, and the separation of concrete from reinforcing.

517.3.6.3 Placement of Reinforcing Bars

The Contractor shall accurately place and secure reinforcing bars in accordance with the Plans, and methods approved by the Project Manager and Precast Inspector. The Contractor shall pay particular attention to concrete cover requirements over reinforcing bars. The Contractor shall provide lap splices in accordance with the approved drawings, and fasten them securely.

517.3.6.4 Placement and Consolidation of Concrete

The Contractor shall place concrete in accordance with Section 511, "Concrete Structures," unless otherwise specified in this section.

Before placing concrete, the Contractor shall correct deficiencies found by the Inspector. To ensure that similar deficiencies do not recur, the Contractor shall implement Quality Control procedures satisfactory to the Inspector.

The Contractor shall use internal vibration to eliminate honeycombing. The Contractor shall attach a sufficient number of external vibrators rigidly to the forms so that the vibrations extend throughout the entire length and volume of the member.

The Department will not allow vibrating methods that cause segregation. The Department will reject members with voids or honeycombing that exposes reinforcement.

517.3.6.5 Tolerances

The maximum allowable deviations from the dimension and details shown in the Contract are listed in the *Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products*, published by the PCI.

517.3.6.6 Curing

The Contractor shall cure precast members in accordance with Section 511, "Concrete Structures." The Contractor may use steam, in accordance with Section 517.3.6.6.1, "Steam Curing."

Before placing concrete, the Contractor shall submit the proposed curing methods and procedures to the Project Manager or the Inspector for approval. The Contractor shall test elevated-temperature curing facilities for a minimum of 48 h before approval. The Contractor shall make curing Equipment and Materials for curing available before casting.

The Project Manager or Inspector will suspend concrete placement if curing facilities are inadequate or the Contractor is not attending to the proper curing of the concrete. Placement may resume after the Contractor makes the appropriate corrections.

The Contractor shall begin curing as soon as possible but not more than two (2) hours after casting. To prevent damage and discoloration of a concrete member, the Contractor shall not allow mats, sheets, or blankets to contact the concrete member.

The Contractor may remove forms after the concrete has reached sufficient strength in accordance with the Specifications for the item being cast. The Contractor shall not interrupt the curing of members for more than 30 min when removing forms.

517.3.6.6.1 Steam Curing

If steam curing; the Contractor shall enclose the member entirely within an approved and supported enclosure so that a clear space forms around the sides, ends, and top of the member.

After placement and vibration of the concrete, the Contractor shall allow it to attain its initial set before applying steam. The Contractor shall prevent surface drying during the period between placement of concrete and application of steam by applying coatings, a membrane curing compound, moisture retention covers, or other equivalent methods.

The Contractor shall ensure that the rate of temperature rise and the maximum temperature, in combination with the cement used in the concrete mix, does not promote or initiate delayed ettringite formation.

The Contractor shall equip each enclosure with accurate temperature recording devices spaced at no more than 100-foot intervals to keep continuous hourly records.

If the air temperature is 40 °F or greater, the Contractor shall not admit steam fog to the enclosure for a period of from two (2) h to six (6) h after final placement of concrete into the forms, to allow the initial set to take place. The Contractor shall maintain the steam fog surrounding the member at a temperature between 120 °F and 165 °F until the member attains the required strength.

If the air temperature is less than 40 °F, the Contractor shall admit steam no hotter than 120 °F to the enclosure immediately. The Contractor shall allow the two (2) to six (6) hour initial setting period to elapse before raising the steam temperature to the specified curing temperature range.

The Contractor shall admit steam into the enclosure at a low pressure and in a saturated condition. The Contractor shall position steam jets so they do not discharge directly onto the concrete, forms, or test cylinders. The Contractor shall carefully check the housing to ensure uniform distribution of steam fog and uniform application of heat and moisture.

When discontinuing the steam, the Contractor shall decrease the temperature of the air surrounding the member at a nearly constant rate not to exceed 70 °F per hour until it reaches a temperature 50 °F above the temperature of the surrounding air. At that time, the Contractor shall terminate the steam curing. The Contractor shall maintain the temperature of the member above 35 °F for four (4) consecutive Days after completion of steam curing.

The Contractor shall remove side forms from six (6) h to two (2) Days after completing the pour. The Contractor shall loosen or remove steel side forms as early as practical to prevent damaging the concrete. The Contractor may interrupt curing briefly for this purpose as long as the surrounding air temperature does not drop below 40 °F.

517.3.7 Workmanship

The Precast Inspector will not reject Work because of fine cracks on the surface of the member that do not extend to the plane of the nearest reinforcement unless they are numerous and extensive. For members with diagonal cracks, which indicate damage from torsion, the Department will perform a structural review before Accepting.

The Contractor shall repair cracks that extend into the plane of the reinforcing steel (but are Acceptable otherwise) by sealing with an approved epoxy or other approved Material.

The Contractor shall repair defective areas or surfaces needing patching using approved methods. The Contractor shall not plaster over defective areas.

Unless otherwise noted, the Contractor shall provide finishes in accordance with Section 511.3.8.2, "Class 1, Ordinary Surface Finish," or Section 511.3.8.3, "Class 2, Rubbed Surface Finish," except for temporary Structures which will require a Class 1 finish. The Contractor shall provide a Class 2 surface finish for visual surface defects/pitting on Structures other than temporary Structures.

517.3.8 Lifting, Handling, Storing, and Shipping Precast Members

The Contractor shall avoid chipping, cracking, fracturing, and excessive bending stresses when lifting, handling, storing, and shipping members. The Contractor shall support members on firm blocks. During handling and storage, the Contractor shall keep the members vertical and the long axis approximately level. The Contractor shall make the points of support and direction of reactions with respect to the member approximately the same as when the member is in its final position in the completed Structure or application. The Contractor shall handle or support the items securely in an upright position.

The Contractor shall use care during lifting, handling, hauling, storing, erecting, and driving to prevent cracking, spalling, or other damage to the member. The Contractor shall replace members damaged by improper handling methods.

The Contractor shall verify lifting devices for capacity in lifting and handling products, taking into account various positions during handling. The Contractor shall not allow lifting devices to project above the surface of the member after placement unless the lifting devices will:

1. Be embedded in a subsequent concrete pour;
2. Have a concrete cover of at least two (2) inches; and
3. Not interfere with the placement of reinforcing steel or concrete.

The Contractor shall stack members in storage only with approval of the Project Manager or the Precast Inspector. The Contractor shall keep members covered and protected until installed.

The Contractor shall not subject members to heavy loads until the members have attained the specified 28-Day strength.

517.3.9 Installation

The Contractor shall install precast Structures in accordance with the Contract.

517.4 METHOD OF MEASUREMENT

The Department will measure precast concrete members in accordance with the applicable sections of the Specifications.

517.5 BASIS OF PAYMENT

The Department will pay for precast concrete members in accordance with the applicable sections of the Specifications.

517.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. The development of the Contractor Quality Control Plan shall be included in the payment and is considered Incidental to the completion of this Bid Item. All references to Section 901.2, "Contractor Quality Control" are for reference only and no separate measurement will be made.

SECTION 518: PRE-STRESSED CONCRETE MEMBERS

518.1 DESCRIPTION

This Work consists of manufacturing and erecting pre-stressed concrete Bridge piles, girders, or other pre-stressed concrete Bridge members.

518.1.1 Pre-Tensioning

Pre-tensioning is tensioning in which the pre-stressing reinforcement is stressed before the Contractor places the concrete. After the concrete attains the required strength, the Contractor releases the pre-stressing force from the external anchorages and transfers that force, by bond, into the concrete.

518.2 MATERIALS

518.2.1 Portland Cement Concrete

The Contractor shall provide an approved State Materials Bureau concrete mix in accordance with the requirements for Special Concrete, as defined in Section 509, "Portland Cement Concrete Mix Designs," and specified compressive strength in accordance with the Contract.

518.2.1.1 Fly Ash

The Contractor shall provide PCC that contains fly ash in accordance with Section 509, "Portland Cement Concrete Mix Designs."

518.2.1.2 Coarse Aggregate

The Contractor shall provide coarse aggregate that consists of Material no larger than one-third (1/3) the size of the smallest clear space into which the Contractor shall place this concrete.

518.2.1.3 Design and Acceptability Requirements

For pre-stressed concrete members, the Contractor shall provide the concrete mix design in accordance with Table 509.2.8.1:1, "Concrete Classes for Laboratory Design of Concrete Mixtures."

The Contractor shall obtain the State Materials Bureau's approval of the concrete mix designs before casting. Once the State Materials Bureau approves a concrete mix design, the Contractor may only make subsequent changes in the mix proportions in accordance with Section 509.2.8, "PCC Mixture Design and Approval."

The Contractor shall enter the actual batch weights used in each batch of concrete and the measured moisture contents for each of the aggregates contained within each batch into the Field Report Form provided to the Contractor/Supplier at the same time the approved mix was provided. Insure that all test results for compressive strength and fresh concrete properties, including slump, air content and unit weight, are also entered into the Field Report.

518.2.1.4 Testing Requirements for Release Strength

The Contractor shall use the Maturity Method as required in Section 510.3.5.2, "Portland Cement Concrete" or make additional field cured cylinders for in-place strength tests (to

determine application of pre-stressing forces). The Contractor shall make at least four (4) field cured cylinders from concrete placed on each casting bed.

The test results shall confirm the compliance with the release strength requirement shown in the Plans.

518.2.1.5 Acceptance Requirements

Compressive strength test shall confirm compliance with Section 510, "Portland Cement Concrete." A test is defined as the average of two (2) or more cylinders from the same sample broken at the same age. The Contractor shall make and cure at least two (2) cylinders per girder or pile from concrete placed in each member and in accordance with AASHTO T 23.

The Contractor shall break at least two (2) cylinders per girder or pile as selected by the Department's Inspector.

The Contractor shall ensure the compressive strength is in accordance with the required 28-Day compressive strength. The Department will not Accept girders or piles with test results less than 90% of the 28-Day required strength. Girders or piles greater than 90% and less than 100% of the 28-Day required strength will be evaluated by the State Bridge Engineer for possible Acceptance.

Girders or piles will not be shipped until the required ultimate compressive strength is confirmed by Maturity Method or compressive strength tests.

518.2.2 Steel Products

518.2.2.1 Reinforcing Steel

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

Reinforcing bars that project from the tops of girder and those within four (4) ft of girder ends shall be uncoated deformed low-carbon, chromium, steel bars conforming to ASTM A1035 or uncoated deformed stainless steel bars conforming to ASTM A955.

518.2.2.2 Pre-Stressing Reinforcement

Pre-stressing reinforcement consists of high strength steel wire, high strength seven (7) wire steel strands, or uncoated high strength steel bars, in accordance with the Contract or as approved by the State Bridge Engineer.

The Contractor shall provide pre-stressing reinforcement that is uncoated, clean, and free of dirt, loose rust, oil, grease, or other Deleterious Material when placed in the member.

518.2.2.2.1 High-Strength Wire

The Contractor shall provide high-strength steel wire in accordance with AASHTO M 204.

518.2.2.2.2 High-Strength Multiple-Wire Steel Strand

The Contractor shall provide high-strength multiple-wire steel strands in accordance with AASHTO M 203M, Supplement S1 (low-relaxation), unless otherwise specified.

518.2.2.2.3 Uncoated High-Strength Steel Bars

The Contractor shall provide uncoated high-strength steel bars in accordance with AASHTO M 275. If the Department allows bars with a greater minimum ultimate strength, the Contractor shall produce and test them in accordance with AASHTO M 275.

518.2.2.2.4 Identification of Pre-Stressing Reinforcement

The Contractor shall assign pre-stressing reinforcement and anchorage assemblies with a lot number and tag for identification purposes. The Department will reject high-strength Materials lacking identification.

518.2.2.2.5 Sampling of Pre-Stressing Reinforcement

The Contractor shall provide samples for further testing if requested by the Department's Inspector.

The Contractor shall provide certification with the samples that states the samples were taken from and are representative of the lot numbers provided.

The Contractor shall provide load elongation curves and mechanical properties representative of the strands or bars to the Department's Inspector.

The Contractor shall sample and test in accordance with AASHTO 203/M 203. If the Department requests, the Contractor shall provide the following:

1. Enough wire to make up one (1) parallel lay strand at least eight (8) ft long, consisting of the same number of wires required for the strand in which they are to be assembled. Cut wires requiring heading for anchoring to length and headed on both ends;
2. At least eight (8) ft of wire strand of each diameter, measured between near ends of fittings. Provide the sample with fittings attached;
3. One completely fabricated pre-stressing tendon ten (10) ft long for each size tendon, including anchorage assemblies;
4. At least eight (8) ft of high-tensile strength bars of each diameter, measured between threads at ends of bars if furnished with threaded ends and nuts, or between anchorage devices; and
5. At least two (2) anchorage assemblies, complete with distribution plates of each size or type, unless such anchorage assemblies are attached to the samples of pre-stressing reinforcement.

The Contractor shall provide Material samples for testing six (6) weeks in advance of the anticipated time for use, to allow testing.

518.2.2.2.6 Protection of Pre-Stressing Steel

The Contractor shall protect pre-stressing steel against physical damage, rust or other results of corrosion, from manufacture to grouting. The Department will reject pre-stressing steel that is physical damaged.

The Contractor shall package pre-stressing steel in containers or other shipping forms to protect the steel against physical damage and corrosion during shipping and storage. The Contractor shall place a corrosion inhibitor that prevents rust or other results of corrosion in the package or form, or apply directly to the steel if the State Bridge Engineer allows. The

Contractor shall ensure the corrosion inhibitor has no damaging effect on the steel or concrete, or bond strength of steel to concrete.

The Contractor shall immediately replace or restore damaged packaging or forms. If using a corrosion-inhibiting carrier-type packaging Material, the Contractor shall provide the Material in accordance with Military Specification MIL-P3420. The Contractor shall clearly mark the shipping package or form with the following:

1. A statement that the package contains high-strength pre-stressing steel;
2. The care in handling;
3. The type, kind, and amount of corrosion inhibitor used, including the date placed or applied;
4. Safety orders; and
5. Instructions for use.

If directed by the State Bridge Engineer or the Department's Precast Inspector, the Contractor shall submit the following for the corrosion inhibitor:

1. A sample, a list of chemicals and their proportions, and instruction for use;
2. Evidence that the pre-stressing steel will be protected from rust and other results of corrosion; and
3. A Certificate of Compliance.

After the Contractor installs the pre-stressing, the Department will not allow the Contractor to weld or have ground welding Equipment on the forms or on the steel in the member.

518.2.2.3 Structural Steel

The Contractor shall provide Structural Steel items in accordance with Section 541, "Steel Structures."

The Contractor shall straighten steel shoe plates prior to casting them in girders.

518.2.2.4 Debonding and Camber Control Sleeves

Sleeves shall have such strength, durability, chemical resistance, and other properties so that the sleeves will provide complete debonding between strands and concrete as called for on the drawings. Debonding and camber control sleeves product information shall be submitted for approval by the State Bridge Engineer.

518.2.3 Mortar

The Contractor shall provide non-shrink mortar used to grout keyways in precast box girders in accordance with Section 521, "Non-Shrink Mortar" with the additional requirement that the non-shrink mortar shall be a commercial pre-blended product from the Department's Approved Product List.

518.3 CONSTRUCTION REQUIREMENTS

518.3.1 Precast Concrete Institute Certified Plant

All prestressed concrete structural members shall be manufactured in a plant certified by the Precast Concrete Institute (PCI). The manufacturer must have a B4 Certification for

Prestressed Deflected-Strand Bridge Member. Certifications must be maintained throughout the production of prestressed concrete structural members. Production will immediately stop if at any time the manufacturer's certification is revoked, regardless of the status of completion of contracted Work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established.

The Department will not be responsible for time, additional compensation or other Project impacts due to lack of certification.

518.3.1.1 Approval of Plants and Equipment

The State Bridge Engineer or the Department's Precast Inspector must approve plants and Equipment for manufacturing pre-stressed concrete members before the Contractor starts the pre-stressed concrete Work. The State Bridge Engineer or the Department's Precast Inspector may forbid unsatisfactory machinery, Equipment, or appurtenances.

518.3.2 Fabrication

518.3.2.1 Forms

The Contractor shall use forms that are smooth, mortar tight, and capable of withstanding the action of form vibrators. The Contractor shall accurately fabricate and secure the forms in position so that the cast member will present true, smooth, and even surfaces.

The Contractor shall construct forms for interior cellular spaces with an approved Material that is watertight, resistant to breakage and deformation, and as lightweight as possible. The Contractor shall anchor interior forms to resist flotation or displacement during concrete placement. The design of interior and exterior forms shall not restrict the longitudinal movement of the member when the Contractor transfers the pre-stressing force to the casting.

518.3.2.2 Placement of Reinforcing Bars and Appurtenances

The Contractor shall place and secure reinforcing bars, forms for cored holes and cellular spaces with methods approved by the State Bridge Engineer. The Contractor shall pay particular attention to concrete cover requirements over reinforcing bars near and at ends of girders.

518.3.2.3 Tensioning

The Contractor shall apply tension to pre-stressing steel with hydraulic jacks to produce forces in accordance with the approved Working Drawings.

During strand stressing, the State Bridge Engineer or the Precast Inspector may Accept individual wire failures, if no more than one (1) wire in any strand is broken and the area of broken wires does not exceed two percent (2%) of the total area of the pre-stressing steel in the member.

The Contractor shall stress the members in a sequence that produces a minimum of eccentric forces.

518.3.2.3.1 Tensioning Equipment

The Contractor shall apply stress to tendons using hydraulic jacks that can provide and sustain the necessary forces and have either a pressure gauge or a load cell for determining jacking stresses.

If necessary, the Contractor shall use a pressure gauge with at least a six (6) inch diameter dial accompanied with a certified calibration chart. The Contractor shall calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force.

If necessary, the Contractor shall calibrate a load cell and provide it with an indicator to determine the pre-stressing force in the tendon. The Contractor shall use a load cell range that does not include the lower ten percent (10%) of the Fabricator's rated capacity to determine the jacking stress.

The Contractor shall use a testing Laboratory approved by the State Bridge Engineer to calibrate the Equipment. The Contractor shall ensure that the Equipment has been calibrated within a year of the Work. The Precast Inspector may check certified calibration charts for the hydraulic jacks, pressure gages, or load cells used for tensioning pre-stressing steel before and during tensioning operations.

518.3.2.3.2 Measurement of Stress

The Contractor shall provide a record of gauge pressures and tendon elongations for each tendon, for review and approval by the Department's Precast Inspector. The Contractor shall measure elongations to an accuracy of within 1/16 inch. The Contractor shall not cut off stressing tails of tendons until the Department's Precast Inspector approves the stressing records.

The Contractor shall use the gauge or load cell readings to determine the stress in the tendons during tensioning and verify with the measured elongations.

The Contractor shall use the modulus of elasticity to calculate anticipated elongations of and base calculations for the nominal area (provided by the Fabricator per lot of tensioned steel), or as determined by a bench test of strands used in the Work.

Before starting elongation readings, the Contractor shall tension the tendons to a preliminary force to eliminate take-up in the tensioning system. The Contractor shall ensure this preliminary force is between five (5) and 25% of the final jacking force. The Contractor shall measure the initial force with a dynamometer or with other approved methods. The Contractor shall mark each strand before the final stressing to permit measurement of elongation and to ensure that anchor wedges are set properly.

The Contractor shall address a discrepancy in indicated stress between jack gauge pressure and elongation. If this occurs, the load used, as indicated by the gauge pressure, will produce a slight overstress rather than understress. The Contractor shall check the entire operation to determine the source of errors, if a discrepancy occurs between gauge pressure and elongation; more than five percent (5%) for tendons longer than 50 ft, or seven percent (7%) for tendons shorter than 50 ft. The Contractor shall correct errors before proceeding.

518.3.2.3.3 Tensioning Pre-tensioned Members

The Contractor may cast several members in a continuous line on the casting bed.

Spools of pre-stressing strand are allowed two (2) splices within the entire spool. The Contractor shall not use strands within each pre-stressed concrete member that have splices.

The Contractor shall accurately locate and hold strands in positions in accordance with the Plans for each individual member. The Contractor shall modify the strand, if the State

Bridge Engineer approves, to ensure that the total pre-stressing force and location of its center of application is not changed.

The Contractor may anchor straight pre-tensioning strands at one end of the casting bed and stress the other end with hydraulic jacks. The Contractor shall tension each individual strand to the required stress. The Contractor shall adopt a method for stressing draped strands that prevents significant stress loss between the jacking and anchor ends of the casting bed. If required to avoid significant stress loss, the Contractor shall stress draped strands from both ends of the casting bed.

The Contractor shall stress or check pre-stressed strands for required stress within 24 h before placing concrete in the member.

The Contractor shall not release or cut pre-tensioned strands until cylinder tests indicate that the concrete in the member has reached the initial unit compressive strength. The Contractor shall remove side forms before releasing the strands. Strands may be flame cut to release stress. The Contractor shall release or cut the strands in accordance with a previously approved sequence to avoid unbalanced forces in excess of that applied by one (1) strand. The Contractor shall trim strands in piles flush with the top and bottom of the piles.

518.3.2.4 Placement and Consolidation of Concrete

The Contractor shall place concrete in accordance with Section 511, "Concrete Structures," and Section 512, "Superstructure Concrete."

The Contractor shall not place concrete until the Precast Inspector has inspected and approved the placement of the items to be embedded in the concrete. The Contractor shall place and secure shoe plates on girders in the exact position in accordance with the Plans.

The Department will allow the placement of concrete in the bottom flange of precast box girders before placement of the interior form and reinforcing bars in the upper portion of the members, if concrete placement is continuous for longer than 30 min.

The Contractor shall use external vibration for precast box girders or to eliminate internal honeycombing. The Contractor shall rigidly attach external vibrators to the forms in sufficient quantity so that the vibration extends throughout the entire length of the member.

The Contractor shall not use vibrating methods that cause segregation. The Department may reject members with voids in piles or in the bottoms of girders and girders or over bearing points, or honeycombing sufficient to expose pre-stressing tendons or reinforcement.

The maximum allowable deviations from the dimensions and details shown in the Contract including camber and sweep will be the dimensional tolerances listed in the *Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products* published by PCI, except as follows:

1. The tolerance on tipping and flushness of shoe plates within 1/16 inch.
2. The tolerance of steel diaphragms attachment holes shall be no greater than 1/16 inch.

518.3.2.5 Finishing Concrete Surfaces

The Contractor shall score top surfaces of girders transversely over the entire flange width to a minimum depth of 1/4 inch and a maximum of 3/8 inch. The Contractor shall clean the top surface of girders after initial set to remove laitance, dirt and debris and to provide a

rough surface.

The Contractor shall finish the top surface of precast box girders and piles by over filling the forms, vibrating, and striking off with a metal plated strike board. On the final forward movement of the strike board, the Contractor shall carry excess mortar ahead to completely fill the form. After striking off the concrete, the Contractor shall finish the surface to a true plane. The Contractor shall ensure that surface irregularities do not exceed 9/16 inch per ten (10) ft. Unless otherwise shown in the Contract, the Contractor shall give the top surface of the precast box girders a final broomed finish to produce transverse corrugations.

If the Contract requires the Contractor to embed the ends of pre-stressed concrete girders in concrete diaphragms, the ends of the girders do not require hand finishing after removal of forms. If the Contract does not require the Contractor to extend strands for field or shop bending to provide continuity reinforcement, the Contractor shall cut the strands three (3) inches or less beyond the girder ends.

The Contractor shall finish girder ends that will not be embedded in concrete and other surfaces of pre-stressed Bridge members in accordance with Section 511.3.8, "Finishing."

518.3.2.6 Curing

The Contractor shall steam cure or water cure precast, pre-stressed members. The Contractor shall not use a curing temperature greater than 160° F. The Contractor shall uniformly increase the temperature to the maximum temperature over a period not less than seven (7) hours. The Contractor shall additionally uniformly reduce the curing temperature such that at least seven (7) hours are required to reduce the temperature of the curing environment.

The Contractor shall perform steam curing in accordance with Section 517, "Precast Concrete Structures."

The Contractor shall perform water curing in accordance with Section 511, "Concrete Structures."

518.3.2.7 Tolerances

The maximum allowable deviations from the dimension and details shown in the Contract are listed in the *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products*, most current version, published by the PCI.

518.3.2.8 Lifting, Handling, Storing and Transporting Precast Members

The Contractor shall not handle members until after applying the pre-stressing force.

The Contractor shall, at all times, keep webs of pre-stressed girders vertical and keep the long axis approximately level. The Contractor shall keep the points of support and direction of reactions in accordance with approved Working Drawings.

The Contractor shall limit the camber growth to a value not to exceed the predicted camber at erection dimension by two (2) inches at the time of deck slab placement for pre-stressed girders greater than 54 inches in depth. Limit camber growth to one (1) inch for pre-stressed girder 54 inches or less. Camber growth is to be limited by methods such as weighting, fabrication scheduling or other Acceptable means. The Contractor shall submit Plan for review to the State Bridge Engineer prior to limiting camber growth. The Plan must be prepared by a Professional Engineer licensed in the State of New Mexico.

The Contractor shall lift girders for handling, transport and erection by means of devices designed or recommended by the Fabricator and approved by the State Bridge Engineer prior to use.

The Contractor shall not crack, spall, or otherwise damage members during lifting, handling, hauling, storing, erecting, or transporting. The Contractor shall replace members damaged by improper handling.

The Contractor shall not transport members to the job site until the required ultimate compressive concrete strength is attained.

518.3.3 Bracing for Girders

The Contractor shall tie and brace the girders immediately after erection to prevent overturning. The Contractor shall leave ties and bracing in place until the girders are permanently secured for lateral stability. If steel girder diaphragms are used, the Contractor shall install diaphragms during girder erection.

518.3.4 Grouting Keyways in Precast Box Girders

The keyways between adjacent precast box girders shall be grouted per Section 521, "Non-Shrink Mortar." The non-shrink mortar shall be commercial pre-blended non-shrink mortar that the Contractor only has to add water. The non-shrink mortar shall be from the Department's Approved Product List.

518.3.5 Quality Control and Quality Assurance

518.3.5.1 Working Drawings

The Contractor shall furnish Working Drawings in conformity with Subsection 105.2, "Plans and Working Drawings" for all Pre-stressed Concrete Members. The Working Drawings that are submitted to the NMDOT shall contain the endorsement seal of a Professional Engineer licensed in the State of New Mexico and with five (5) years experience with prestressed concrete experience. NMDOT review of the Working Drawings does not relieve the Contractor of the responsibility for the adequacy of the prestressed members. The Contractor shall submit supporting calculations for the Working Drawings. The Contractor shall allow 30 Days for review and Acceptance of Working Drawings and calculations. Any re-submittals will require an additional 14 Days for review.

The Working Drawings shall include the following:

1. All unit dimensions.
2. Location, size, and type of prestressing strands.
3. Initial and final jacking forces.
4. Location, description, and detail of structural reinforcing items.
5. Location of all hold-down devices.
6. Location and shop drawings of all steel items. Shop drawings shall be per AASHTO/NSBA G1.3, Shop Drawing Presentation Guidelines.
7. Details for steel diaphragm connections.
8. Blockout and keyway dimensions, if any.
9. Location and detail of debonded strands.

10. Rebar schedule per ACI Detailing Manual SP-66.
11. Framing Plan with the Fabricators mark numbers.
12. Embeds for overhang brackets and permanent steel deck forms.
13. Stresses in the top and bottom of the pre-stressed concrete members during detensioning of the strands.
14. The predicted girder shortening, camber at release, and camber at 90 Days.
15. Detail Drawings, written procedures, and calculations for the special design such as camber control using prestressing top strands.
16. Handling, storing and transportation details.

518.3.5.2 Notification of Fabrication for Pre-stressed Concrete Members

1. *Start of Work.* Prior to beginning the Work, the Contractor shall provide written notice to the Quality Assurance (QA) Representative, as defined in Subsection 518.3.5.3, "Inspection of Pre-stressed Concrete Members" so that QA services may be provided. The written notice shall be received at least seven (7) Days before fabrication begins.

The anticipated production schedule, including the start of Work, phase Work and shipment dates shall be submitted in writing to the QA Representative before any Work begins. Fabrication shall not be started until the Working Drawings submittal have been returned with the NMDOT Engineer's review stamp, indicating Reviewed, no exception taken; or reviewed, revise as noted and delivered to the Contractor's site of fabrication.

2. *Production Schedule Changes.* Accelerated changes to the proposed production schedule, including start of Work, phase Work, and shipment dates, shall require advance written notification be provided to the QA Representative. The written notice of change shall be received at least 48 hours before fabrication begins, unless otherwise approved in writing by the QA Representative.
3. *Notice of Shipment.* The QA Representative shall be notified in writing, at least 72 hours before shipment of prestressed members to the job site.
4. *Notification.* Failure to notify the designated QA Representative as described in this section may be cause for rejection.

518.3.5.3 Inspection of Pre-stressed Concrete Members

1. *Quality Control and Quality Assurance.* Quality Control (QC) of prestressed concrete fabrication is the responsibility of the Contractor. The Contractor shall designate a QC Manager who shall be responsible for product quality requirements as defined in the Specifications and the Contractor's approved QC Plan (QCP). The QC Manager shall possess and maintain certification at Level II minimum, from the Prestressed Concrete Institute (PCI), and shall have one (1) year minimum of construction related experience. The QC Manager shall not be supervised by the Contractor's production section.

Quality Assurance and product Acceptance are the prerogatives of the NMDOT. The Department's Precast Inspector will be the QA Representative and acts for and in behalf of the NMDOT on all matters within the scope of the Contract documents. QA administration will be performed to the extent necessary to assure Contract compliance.

Repeated out of tolerance Work, including dimensional Non-Conformance, shall be considered as recurring deficiencies. Recurring deficiencies shall be considered as

evidence that required QC is not being provided. When the QA Representative determines that fabrication operations are producing recurring defects that do not conform to the Contract and the QCP requirements, the Contractor will be notified that the present Work is unacceptable. Work shall not continue until the QC Manager has submitted a written proposal addressing corrective procedures that the Contractor will take to prevent recurrence of the Non-conforming Work. Fabrication shall not resume until the proposal has been reviewed and Accepted in writing by the QA Representative.

2. *Quality Control Plan (QCP)*. The Contractor shall submit a written QCP to the QA Representative prior to the beginning of fabrication. The QCP shall be reviewed and approved in writing by the Contractor's QC Manager. The QCP shall list all methods utilized by the Contractor to ensure that the Work conforms to Contract requirements. The QC section is responsible for establishing the QCP, as well as conformance to the QCP. Fabrication shall not begin until the QCP has been reviewed and Accepted in writing by the QA Representative.

If Work methods for a specific Project or product are not listed in the original QCP, the Contractor shall submit written addenda addressing the proposed methods that are necessary to meet Contract requirements. Fabrication shall not begin until the addenda have been reviewed and Accepted in writing by the QA Representative.

The QCP shall address the following:

- a. Names and qualifications of the QC Manager and personnel conducting inspection and testing. This list shall be updated when changes in personnel occur. Copies of the training certificates of the personnel conducting inspection and testing shall be submitted to QA Representative.
 - b. List of Material Suppliers and certified testing laboratories used; the list shall be updated when vendors change.
 - c. Materials sampling and testing schedule, showing testing methods and frequencies.
 - d. QC inspection methods and procedures for all stages of fabrication operations.
 - e. Methods for curing products and test specimens.
 - f. Method and sequence for tensioning strands, including methods used for verifying equal distribution of jacking forces.
 - g. Method and sequence of detensioning strands.
 - h. Written report format for Materials sampling, testing, and inspection for all phases of the Work.
 - i. Copies of all concrete mix designs to be used, including mix design computations and test data.
 - j. Provisions for fabrication operations during cold, windy, or hot weather conditions.
 - k. Procedures for patching small production holes and holes left by strand hold-down devices.
 - l. Procedures for identifying, evaluating and reporting defects, including dimensional Non-Conformance, discovered during QC/QA inspections and testing.
 - m. Procedures for notifying the QA Representative and the State Bridge Engineer of structural defects, and submittal of written proposal for repairs.
3. *Frequency*. QC inspection and testing at all intervals of forming, tensioning, steel and concrete placement, curing, and storage operations shall be performed in accordance with the Accepted QCP and Contract requirements. The QCP shall

contain provisions for increased frequencies of inspection and testing when operations or products do not conform to the Contract.

4. *Written Records and Reports.* The QC Manager shall review and submit the following completed records and reports to the QA Representative before the product receives Acceptance by the QC section:
 - a. Prestressing Steel - Tensioning reports for each setup, showing the jacking force calculations; initial and final jacking force used; calculated and final net measured elongation; applicable stressing corrections for seating, slippage, shortening, rotation movement, and temperature; Certified Mill Test Reports for prestressing steel used.
 - b. Concrete - A daily report of each mix design used, showing the fresh concrete slump, temperature, unit weight, and air content (if specified). The daily report shall also include the following data:
 - i. Date and time of casting.
 - ii. Bed and setup location.
 - iii. Ambient conditions.
 - iv. Total cubic yards placed;
 - v. Girder mark and unique sub-mark identifications.
 - vi. Actual product curing temperature charts or graphs.
 - vii. Actual curing enclosure humidity charts or graphs.
 - viii. Average release strength in psi.
 - ix. Date and time of release strength.
 - x. Copies of individual batch tickets when requested by the QA Representative.
 - c. Pre-pour Inspection Records shall include the items to be checked as listed in the QCP.
 - d. Post-pour Inspection Records shall include the items to be checked as listed in the QCP. These records shall include all discovered variances from product dimensional tolerances.
 - e. Report of minor repairs made to each individual product.
 - f. The following written records shall be submitted to the QA Representative before product shipment:
 - i. Length measurement of girders within three (3) Days prior to shipping.
 - ii. Product camber measurement within seven (7) Days prior to shipping.

518.4 METHOD OF MEASUREMENT

Pre-stressed concrete members will be measured by the linear foot.

518.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Pre-stressed Concrete Member Type</i>	Linear Foot

518.5.1 Work Included In Payment

The following items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Prestressing steel, reinforcing steel and embedded steel items for precast prestressed concrete Bridge members.
2. The Quality Control and Quality Assurance requirements.
3. Shipping and erecting Pre-stressed Concrete members.

The development of the Contractor Quality Control Plan shall be included in the payment and is considered incidental to the completion of this Bid Item. All references to Section 901.2, "Contractor Quality Control" are for reference only and no separate measurement will be made.

SECTION 519: SHOTCRETE

519.1 DESCRIPTION

This Work consists of constructing a pneumatically applied non-structural shotcrete onto rock, soil or structural shotcrete onto formed surfaces in accordance with the Contract and as directed by the Project Manager.

These Specifications refer to premixed cement and aggregate pneumatically applied by suitable Equipment and competent operators.

519.2 MATERIALS

Structural shotcrete shall have a design strength of 4000 psi at 28 Days. If structural shotcrete is required, the Contractor shall use a shotcrete mix that has been designed and proportioned in accordance with Section 509, "Portland Cement Concrete Mix Designs" and complies with the designated hardened properties for the class of concrete required in the specifications. All mix constituents must comply with Table 519.2:1, "Applicable Specification Sections." The Contractor shall determine all hardened properties in accordance with Section 519.2.6, "Acceptance Sampling and Testing."

Non-structural shotcrete shall have a design strength of 3000 psi at 28 Days. If the shotcrete is non-structural, the non-structural shotcrete mix design may be developed in accordance with Section 509, "Portland Cement Concrete Mix Designs" without using the special boxes required in Section 519.2.6, "Acceptance Sampling and Testing."

All shotcrete mix designs must be reviewed and approved by the State Concrete Engineer before being used on NMDOT Projects. The Contractor shall use either wet-mix or dry-mix shotcrete. The Contractor shall reinforce shotcrete in accordance with the Contract.

The Contractor shall provide Materials and perform construction requirements in accordance with the specification sections listed in Table 519.2:1, "Applicable Specification Sections."

**Table 519.2:1
Applicable Specification Sections**

Material/Construction Requirements	Section
Portland cement	Section 509, "Portland Cement Concrete Mix Designs"
Fly Ash	Section 509, "Portland Cement Concrete Mix Designs"
Pozzolans	Section 509, "Portland Cement Concrete Mix Designs"
Curing Materials and Admixtures	Section 509, "Portland Cement Concrete Mix Designs"
Water	Section 509, "Portland Cement Concrete Mix Designs"
Fine Aggregate	Section 509, "Portland Cement Concrete Mix Designs"
Coarse Aggregate	Section 509, "Portland Cement Concrete Mix Designs"
Neat Cement Grout	Section 521, "Non-Shrink Mortar"

**Table 519.2:1
Applicable Specification Sections**

Material/Construction Requirements	Section
Bar Reinforcement	Section 540, "Steel Reinforcement"
Welded Wire Fabric	Section 540, "Steel Reinforcement"
Surface evaporation	Section 512, "Superstructure Concrete"

519.2.1 Fine Aggregate Quality Requirements

The Contractor shall provide fine aggregate with the following properties:

1. A soundness Loss of 12 or less when tested in accordance with AASHTO T 104 using magnesium sulfate solution and a test duration of five (5) cycles; and
2. A sand equivalent of at least 75 when tested in accordance with AASHTO T 176.

519.2.2 Fine Aggregate Gradation Requirements

Fine aggregates shall comply with Table 519.2.2:1, "Fine Aggregate Gradation" for either Grading No.1 or Grading No. 2.

**Table 519.2.2:1
Fine Aggregate Gradation**

Sieve Size, U.S. Standard Square Mesh	Percent by Weight Passing Individual Sieves	
	Grading No.1	Grading No.2
¾ inch (19 mm)	---	---
½ inch (12 mm)	---	100
3/8 inch (10 mm)	100	90 to 100
No. 4 (4.75 mm)	95 to 100	70 to 85
No. 8 (2.4 mm)	80 to 98	50 to 70
No. 16 (1.2 mm)	50 to 85	35 to 55
No. 30 (600 µm)	25 to 60	20 to 35
No. 50 (300 µm)	10 to 30	8 to 20
No. 100 (150 µm)	2 to 10	2 to 10

519.2.3 Water

The Contractor shall use water in the shotcrete mix that is free of elements that could stain the mix and in accordance with Section 509.2.6, "Water."

519.2.4 Anchor Bars

The Contractor shall provide anchors of appropriate size to hold reinforcement in place. The Department will allow maximum anchor spacing of 24 inches on a grid pattern over the entire area for structural applications.

If using "L"-shaped anchors, the Contractor shall use those that consist of No. 5 reinforcement bars (or larger) bent into an "L" shape. The short leg of the "L" will be at least six (6) inches long and the long leg at least two (2) feet long.

519.2.5 Welded Wire Mesh

The Contractor shall provide non-galvanized eight (8) gauge steel with a four (4) inch × four (4) inch mesh (4 × 4-W2.1 × W2.1) in accordance with Section 540, "Steel Reinforcement" for welded wire mesh. For structural applications, the Contractor shall use welded wire mesh in accordance with the Contract and as approved by the State Bridge Engineer. The Contractor shall ensure that all wire mesh has been rigidly fixed in place to prevent rebound when struck by the shotcrete.

519.2.6 Fiber Reinforcement

Synthetic Fibers shall meet the requirements of ASTM C1116.

Steel fibers should meet the requirements set forth in ASTM A820.

519.2.7 Prepackaged Product

For non-structural shotcrete; a pre-mixed and prepackaged concrete product, with or without steel fibers, specifically manufactured as a shotcrete product for on-site mixed shotcrete, may be used if approved by the State Materials Bureau. The Material shall meet the requirements of ASTM C1480 and have a minimum strength of 3,000 psi at 28 Days for non-structural Shotcrete.

519.2.8 Acceptance Sampling and Testing for Structural and non-structural Shotcrete

The Contractor shall apply shotcrete to approved test panels. The Contractor shall orient the spray nozzle to the test panel in the same position as that used on the actual Project. The Contractor shall provide test panels constructed in accordance with the requirements of ASTM C 1140. The Contractor shall use test panels with the following characteristics:

1. Minimum dimensions of 30 inch² × eight (8) inch deep;
2. Constructed from wood and sealed plywood; and
3. 45° sloped sides to allow rebound to escape.

The Contractor shall use at least one (1) pre-construction trial to do the following:

1. Obtain test cores to confirm compliance with the hardened properties of Section 510, "Portland Cement Concrete."
2. For structural Shotcrete only, pre-qualify the proposed nozzle operator and strike-off persons. The Department will not allow nozzle operators and strike-off persons who have not been pre-qualified to apply shotcrete on the Project. Each nozzle operator and strike-off person shall shoot pre-construction test panels in the presence of the Project Manager or designated representative. Each nozzle operator shall have a minimum of the following qualifications:
 - 2.1. Supervisor, at least one (1) year of experience as a shotcrete nozzle operator and at least two (2) years of experience on shotcrete Projects.
 - 2.2. Nozzle operator and delivery Equipment operators, at least one (1) year of apprenticeship on similar applications with the same type of Equipment.
 - 2.3. Nozzle operators shall be ACI Certified Shotcrete Nozzle Operators.

The Contractor shall perform curing, coring, and testing of the shotcrete test panels and specimens at a private testing Laboratory approved by the State Materials Bureau for concrete mix designs.

The Contractor shall provide one half of the test panels with reinforcement and anchors representative of the same size and spacing required in the Contract for the actual Work. The Contractor shall provide the remaining panels with no reinforcement to allow for extraction of shotcrete test cores for compliance testing.

Each nozzle operator proposed for use on the Project shall shoot at least one (1) test panel at each orientation.

The Contractor shall obtain the required number of test cores in accordance with Section 510, "Portland Cement Concrete," from these test panels for testing at the designated ages for the specified performance parameters. The Contractor shall extract a minimum of three (3) four (4) inch diameter cores from locations of intersecting reinforcing steel and mesh to check the adequacy of consolidation of shotcrete around and behind the reinforcement. The Contractor shall take at least one (1) core at an anchor location.

The State Materials Bureau will evaluate the quality of the extracted cores and test panels. If the Department rejects a prequalification test panel, the Contractor shall have the nozzle operator shoot a second test panel. If the Department rejects the second test panel, the Contractor shall not allow the nozzle operator to shoot on the Project until the operator completes an appropriate training program and prepares an acceptable test panel.

The Contractor shall transport test panels in the wooden forms with care to not crack or damage the specimens.

The Contractor shall place the test panels in a moist room in the Laboratory that is maintained at a temperature of $73^{\circ}\text{F} \pm 3^{\circ}\text{F}$, and a relative humidity of $98 \pm$ two percent (2%). After three (3) Days, the Contractor shall remove the test panels from the wooden forms and return them to the moist room until testing time.

519.2.8.1 Production Testing for Structural Shotcrete

The Contractor shall shoot two (2) construction test panels for each nozzle orientation and for each nozzle operator each Day of shotcrete production in the presence of the Project Manager. The Contractor shall shoot one (1) set of panels for each nozzle operator in the morning and one (1) set of panels for each nozzle operator in the afternoon for a full Day's production.

The Contractor shall produce test panels in accordance with ASTM C 1140, a minimum 12 inch² × eight (8) inch deep. The Contractor shall use test panels constructed of wood and sealed plywood with 45° sloped sides to permit escape of rebound. The Contractor shall provide construction test panels that contain no reinforcement or embedments.

The Contractor shall store, handle, and cure construction test panels the same as specified for pre-construction test panels. The Contractor shall prepare test specimens the same as specified for pre-construction test specimens.

The Contractor shall use compressive strength test specimens that are four (4) inch × eight (8) inch cores (length/diameter ratio of 2:1).

The mean compressive strength is acceptable if the average of three (3) cores tested at the specified age is equal to or greater than 85% of the specified strength, with no individual

strength test being less than 75% of the specified strength.

The Contractor shall correct unacceptable shotcrete sections at no additional cost to the Department.

519.3 CONSTRUCTION REQUIREMENTS

519.3.1 Equipment

519.3.1.1 Shotcrete Placing Equipment

The Contractor shall apply wet mix shotcrete with one (1) of the following methods:

1. The "thick-stream" method, which involves the use of a regular concrete pump with air addition at the discharge nozzle to pneumatically apply the shotcrete on the receiving surface. The "thick-stream" method usually uses a two (2) inch to 2 1/2 inch internal diameter delivery hose.
2. The "thin-stream" method, which normally involves the use of a pressurized chamber to pneumatically send the shotcrete down the delivery hose to the receiving surface. The "thin-stream" method normally uses a hose with a maximum 1 1/2 inch internal diameter.

The Contractor shall only use the "thin-stream" method for non-structural shotcrete if pre-construction testing confirms the capability to properly consolidate shotcrete, fully encase reinforcing steel, and produce a Material that meets the required hardened properties.

The Contractor shall use shotcrete delivery Equipment in accordance with ACI 506R and that is capable of delivering a steady stream of uniformly mixed Material to the discharge nozzle at the proper velocity and rate of discharge.

The preferred type of the wet-mix shotcrete delivery system uses positive displacement pumps equipped with hydraulic or mechanically powered pistons (similar to conventional concrete piston pumps), surge-reduction devices, and compressed air added at the discharge nozzle. The Contractor may use pneumatic-feed guns, rotary-type feed guns (similar to dry-mix guns), and peristaltic squeeze-type pumps if the Contractor demonstrates that the guns can produce shotcrete in accordance with the performance requirements and the Project Manager approves.

The Contractor shall carefully monitor the air ring at the nozzle for signs of blockage of individual air holes. If non-uniform discharge of shotcrete becomes apparent, the Contractor shall stop shooting and clean the air ring or take other appropriate corrective actions.

The Contractor shall thoroughly clean the delivery Equipment at the end of each shift. The Contractor shall remove build-up of coatings in the delivery hose and nozzle liner. The Contractor shall regularly inspect the air ring and nozzle and replace as necessary.

519.3.1.2 Auxiliary Shotcrete Equipment

The Contractor shall supply a clean, dry air supply capable of maintaining sufficient nozzle velocity and simultaneous operation of a blow pipe.

The Contractor shall use an air supply system with a moisture and oil trap.

The Contractor shall provide auxiliary shotcrete Equipment, such as air delivery hoses, blow pipes, couplings, admixture dispensers, and fiber feeders, in accordance with the

recommendations of ACI 506R.

519.3.2 Batching and Mixing Shotcrete

519.3.2.1 Wet Mix Process

The Contractor shall batch, mix, and supply wet mix shotcrete using one (1) of the following systems:

1. Central Mixing with transit delivery; or
2. Transit mixing and delivery.

519.3.2.1.1 Central Mixing and Supply

The Contractor shall batch and mix ingredients in accordance with Section 510, "Portland Cement Concrete." The Contractor shall provide inspected transit mixers in accordance with Section 510, "Portland Cement Concrete."

The Contractor may only re-temper the shotcrete once with superplasticizer added directly to the transit mixer during the period of discharge to maintain workability (slump) of shotcrete. The Contractor shall mix the shotcrete for a minimum period of five (5) min at the rated mixing speed after adding the superplasticizer to the transit mixer.

The Contractor shall shoot shotcrete within 90 min of adding mix water to the batch. The Contractor shall use appropriate shotcrete batch sizes per load to meet this requirement.

519.3.2.1.2 Transit Mixing and Supply

The Contractor shall apply central mixing requirements to transit mixing, except add ingredients directly to the transit mixer, not the central mixer. The Contractor shall not charge transit mixers to more than 70% of their rated capacity.

519.3.2.2 Dry Mix Process for Non-Structural Shotcrete

The Contractor shall batch the cement and aggregate by weight directly at the Project site within the tolerances required in Section 510, "Portland Cement Concrete."

The Contractor shall pre-dampen the dry mix before flow into the main hopper and immediately after flow out of the packaging to ensure uniform shotcrete free of dry pockets.

The Contractor shall not use pre-dampened cement/aggregate mixtures that are more than 90 min old or that are unable to produce the specified hardened properties.

519.3.2.3 Batching and Mixing Steel Fibers

The Contractor shall submit the procedure used for adding steel fibers to the shotcrete to the Project Manager for approval. The Contractor shall demonstrate the procedure in the field to the satisfaction of the Project Manager before starting production operations.

If fiber addition takes place at the nozzle, the Contractor shall uniformly distribute fibers throughout the mortar matrix without isolated concentrations (clumping or balling).

If adding fibers to the dry or wet mix during the batching and mixing process, the Contractor shall use a screen with a mesh of from 1 1/2 inch to 2 1/2 inch to prevent fiber balls from entering the shotcrete line. The Department will not require batching through a screen if

the Contractor demonstrates that fiber balls are not forming.

The Contractor shall not add fibers to the dry or wet mix too quickly (so they can be blended with the other ingredients without forming balls or clumps). The Contractor shall use a vibrating screen or sift to pass bulk fibers (that have a tendency to stick) into the mix as individual elements and not as clumps.

519.3.2.4 Preparation and Hardware

519.3.2.4.1 Subsurface Preparation

The Contractor shall locate and remove loose, spalled, deteriorated, and delaminated concrete, stone, or other substrate. The Contractor shall use hammer sounding to locate specific de-laminated areas of concrete or rock. The Contractor shall not damage areas of sound concrete or reinforcing steel during concrete removal operations.

The Contractor shall remove concrete using one (1) or more of the following methods:

1. Chip with light duty pneumatic, or electric, chipping hammers (not to exceed 15 lb).
2. Scarifiers, scabblers or other suitable mechanical means.
3. High-pressure (15,000 psi to 40,000 psi) water jetting. (If using water jetting, do not allow water to collect so that surrounding areas are not contaminated or damaged.)

If the Contractor exposes corroded reinforcing steel, the Contractor shall continue concrete removal until there is a minimum 3/4 inch clearance around the exposed, corroded reinforcing bar. The Contractor shall not damage the bond to adjacent non-exposed reinforcing steel during concrete removal.

The Contractor shall taper the perimeter of removed concrete areas at approximately 45° angles. The Contractor shall sawcut the outer edges of chipped areas to a minimum depth of 3/4 inch to avoid feather edging.

The Contractor shall use abrasive blast cleaning to remove fractured surface concrete and traces of unsound Material or contaminants, such as oil, grease, dirt, slurry or Materials that could interfere with the bond of the freshly placed shotcrete. The Contractor shall apply shotcrete to abrasive blast cleaned areas within 48 h or re-blast them.

The Project Manager may waive the requirement for abrasive blast cleaning where the Contractor performed concrete removal with high-pressure water blasting and the prepared surface is free of residual slurry or other Material detrimental to an Acceptable shotcrete bond.

The Contractor shall install reinforcement in slope blankets that do not contain steel reinforcement. Unless otherwise specified, the reinforcement will consist of No. 4 steel reinforcing bars placed with maximum spacing of 12 inch for vertical and horizontal bars. The Contractor shall rigidly attach this reinforcement to the underlying forms or concrete Structure. The Contractor shall remove dust, debris, or laitance generated by this process in accordance with these abrasive blast cleaning procedures.

519.3.2.4.2 Repair or Replacement of Steel Reinforcement

If the Contractor exposes corroded reinforcing steel during concrete removal, the Contractor shall remove corrosion using abrasive grit blasting.

The Contractor shall remove and replace reinforcing steel displaying deep pitting or loss of more than 20% of cross-sectional area as directed by the Project Manager.

If pitting is isolated, the Contractor shall reinforce the steel by adding appropriately placed reinforcing bars of suitable length (the existing reinforcing steel need not be cut).

519.3.2.4.3 Steel Reinforcement

The Contractor shall use a minimum lap splice length of reinforcing steel that is in accordance with the AASHTO *LRFD Bridge Design Specification*. The Contractor shall place these bars in accordance with ACI 506R, Sections 5.4 and 5.5. In particular, the Contractor shall not bundle bars in lapped splices; place them so the minimum spacing around each bar is three (3) times the maximum aggregate size to allow for proper shotcrete encapsulation.

The Contractor shall tightly secure intersecting reinforcing steel bars to each other using 12 gauge or heavier tie wire and adequately support them to minimize vibration during shotcrete placement.

The Contractor shall place welded wire mesh fabric in accordance with the Contract. The Contractor shall lap sheets of adjoining mesh by at least two (2) spaces in both directions at intersections, and securely fasten.

The Contractor shall fasten mesh to preset or existing anchors and reinforce using 12 gauge or heavier tie wire on a grid not less than 12 inch². The Contractor shall avoid large knots of tie wire that could result in sand pockets and voids during shotcreting.

The Contractor shall provide a minimum clearance of 3/4 inch behind installed reinforcing steel or mesh and existing concrete forms or bare rock.

519.3.2.4.4 Structural Anchors

Unless otherwise specified in the Contract, the Contractor shall place anchor bars (for structural applications) at a maximum spacing of 24 inches on a grid pattern over the entire area.

The Contractor shall provide the types of anchors in accordance with the Contract and either mechanically set or grout, as specified.

The Contractor shall ensure anchors develop the minimum pullout force in accordance with the Contract. The Contractor shall randomly test anchors at a frequency in accordance with the Contract to verify pullout force. The Department will not accept a pull out force less than 150 lb. If anchors fail to meet the minimum acceptable pullout value, the Contractor shall remove and replace immediately and take corrective action. Also, the Contractor shall test the anchors in the same relative location as those that failed. The Project Manager will determine the area for corrective measures.

519.3.2.4.5 Non-Structural Anchors

For non-structural applications (slope blankets, etc.), the Contractor shall install anchor bars at ten (10) foot centers on a grid pattern over the entire area in one (1) inch diameter holes drilled into the rock or soil approximately 24 inches deep.

The Contractor shall completely fill the drilled hole with neat cement grout using a grout tube extending to the bottom of the hole.

The Contractor shall push the anchor bar into the grout-filled hole and center it such that the short leg of the "L"-shaped bar points upward and parallel to the slope and is located

approximately 1 1/2 inches from the rock or soil surface.

519.3.2.4.6 Weep Holes

For slope blankets, the Contractor shall provide weep holes throughout the shotcrete mat on maximum ten (10) foot centers, horizontally and vertically.

The weep hole drains will consist of two (2) inch diameter Schedule 40 PVC slotted drainpipe, two (2) feet in length, placed within predrilled holes and sloped five percent (5%) to drain. The exposed end will extend from one (1) inch to three (3) inch outside the slope.

The Department will not allow pre-drilled holes with diameters larger than three (3) inches.

The Contractor shall install the slotted drainpipe before placing shotcrete. During placement of shotcrete, the Contractor shall protect weep holes and drainpipes against contamination.

519.3.2.4.7 Alignment Control and Cover

The Contractor shall implement alignment control (to establish control over line and grade), and maintain the minimum specified shotcrete thickness and cover of reinforcing steel.

The Contractor shall perform alignment control with shooting wires (also called ground wires), guide strips, depth gauges, or forms. The Contractor shall submit the proposed means of alignment control to the Project Manager for review and approval.

The Contractor shall use shooting wires that are at least "piano wire"--sized high-strength steel wire combined with a turnbuckle and spring coil. The Contractor shall remove shooting wires after completion of shotcreting and screeding operations.

The Contractor shall not let guide strips and forms impede the ability of the nozzle operator to produce uniform, dense, properly consolidated shotcrete. The Contractor shall not use alignment control Material that causes the formation of sand-pockets and voids.

If using depth gauges for alignment control, the Contractor shall space no greater than four (4) ft in a grid pattern. The Contractor shall cut back metal depth gauges to 1/4 inch below the finished surface.

The Contractor shall cover reinforcing steel in accordance with Section 540, "Steel Reinforcement."

519.3.3 Quality Assurance and Quality Control Testing

519.3.3.1 Quality Assurance

The Department will implement a Quality Assurance Program for the shotcrete Work. The program will include the following:

1. Review of Contractor submittals;
2. Review of the approval of Contractor-proposed Materials, supply, Equipment, and crew. In particular, evaluation in the pre-construction testing program of shotcrete nozzle operator and strike-off person proposed for use on the Project; the Department will allow only nozzle operators and strike-off persons approved in writing by the State Materials Bureau to perform Work;

3. Examination and approval (before application of any shotcrete) of areas prepared for shotcreting, including installation of anchors, reinforcement, and alignment control devices;
4. Provision of Inspectors to monitor shotcrete installation and authority to require removal and replacement of defective shotcrete while still plastic;
5. Regular monitoring of Quality Control testing results;
6. Implementation of a program for in-place evaluation and Acceptance or rejection, if test results indicate shotcrete is unacceptable; and
7. Implementation of a program of remedial Work, if the Quality Assurance Program deems it necessary.

519.3.3.2 Quality Control Testing

The Contractor shall provide an independent testing Laboratory to establish and maintain a Quality Control program for the shotcrete Work to ensure compliance with Section 519, "Shotcrete." Such a program will include, but not be limited to, the following:

1. Maintenance of test records for Quality Control operations; and
2. Physical testing in accordance with Section 519.2.6.1, "Production Testing" for the confirmation of compliance with the specified hardened shotcrete properties.

519.3.3.3 Safety and Cleanup

519.3.3.3.1 Preparation

The Contractor shall implement a safety program during preparation for shotcreting to do the following:

1. Protect the structural integrity of structural elements (by shoring or other suitable means) during concrete and reinforcing steel removal operations.
2. Protect personnel from falling debris, blasting grit, and high-pressure water jets during concrete removal processes.

The Contractor shall dispose of debris, blasting grit, and hydro-demolition and water-jetting slurry in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public."

519.3.3.3.2 Shotcrete Operations

The Contractor shall implement a safety program using hoarding, shrouds, screens, or other appropriate measures to protect personnel and surrounding property from pneumatically applied shotcrete over-spray and rebound Materials during the shotcrete application process.

Personnel working near the shotcreting operation, including nozzle operator, strike-off persons, nozzle operator's helpers, supervisors, and Inspectors, shall wear appropriate protective Equipment. Such Equipment includes, but is not limited to, safety helmet, safety boots, gloves, appropriate clothing, safety glasses with side enclosures, and dust masks.

Nozzle operator's helpers shall keep a supply of water, cloth or towel, and backup safety glasses available for the nozzle operator so satisfactory vision can be maintained during shooting operations. The Contractor shall provide sufficient lighting so the nozzle operator has a clear view of the Work.

The Contractor shall provide readily available eyebaths and wash facilities in the

immediate vicinity of the shotcrete application. The shotcrete crew shall apply appropriate skin protection and adopt Work hygiene to protect against cement or accelerator alkali burn.

The Contractor shall install sufficient lighting and ventilation to provide the nozzle operator and helpers with clear, unhindered view of the shooting area. The Contractor shall terminate Work and adopt corrective measures if, in the opinion of the Project Manager, visibility is unsuitable for the safe application of quality shotcrete.

519.3.4 Shotcrete Application and Finishing

519.3.4.1 Shotcrete Application

The Project Manager will review and approve areas prepared for shotcrete application before application of shotcrete.

The Contractor shall flush surfaces with water at least one (1) hour before application of shotcrete. The Contractor shall allow flushed surfaces to dry back to saturated surface-dry condition before application of shotcrete. If necessary, the Contractor shall use a blowpipe with oil-free compressed air to facilitate removal of surface water. For very porous and dry substrates, the Contractor shall saturate the substrate the Day before shotcreting and then re-wet before shooting as described above.

The Contractor shall apply shotcrete in accordance with ACI 506R, except that if using silica-fume modified shotcrete; the Contractor may apply the full thickness of shotcrete in a single layer. The Contractor shall use the minimum number of layers required to build up the full thickness of shotcrete without sagging, separation, or sloughing. Wherever possible, the Contractor shall apply shotcrete to the full thickness in a single layer.

If using multiple-layer shotcrete construction, the Contractor shall prepare the first layer with one (1) of the following methods before applying a subsequent layer:

1. Broom the stiffening layer with a stiff bristle broom to remove loose Material, rebound, over-spray, or glaze, before the shotcrete attains initial set.
2. If the shotcrete has set, Delay surface preparation at least 24 h, then prepare the surface by sandblasting or high-pressure water blasting to remove loose Material, rebound, hardened over-spray, glaze, or other Material detrimental to good bond.

When successive layers of shotcrete are necessary to build up full shotcrete thickness, the Contractor shall prevent the first layer from drying out with fogging or wetting. The Contractor shall only use curing compound with the approval of the Project Manager. If using a curing compound, the Contractor shall remove it by abrasive blast cleaning or high-pressure water blasting, before application of the next layer of shotcrete. The Contractor shall clean the first layer of shotcrete of surface water and ensure it is in a saturated surface-dry condition when applying the next shotcrete layer.

The Contractor shall exercise care to protect adjacent surfaces from buildup of rebound and over-spray. The Department will not allow rebound and over-spray on the completed Work. The Contractor shall remove rebound and over-spray from surfaces to receive shotcrete while the Material is still plastic, using blowpipes, scrapers, wire brushes, or other suitable tools. The Contractor shall remove hardened rebound and overspray with abrasive blast cleaning, chipping hammers, high-pressure water blasting or other suitable techniques before applying additional shotcrete.

The Contractor shall provide scaffolding or other devices so the nozzle operator and helpers have free, unhindered access to the Work area.

The Contractor shall apply shotcrete from the nozzle in accordance with ACI 506R.

The Contractor shall not apply shotcrete during periods of rain or high wind, unless suitable protection is provided.

The Contractor shall apply shotcrete in accordance with the Contract using shooting wires, depth gauges, guide strips, forms, or other suitable devices. The Contractor shall apply the minimum cover of shotcrete to reinforcing steel in accordance with the Plans. The Contractor shall cut back metal depth gauges to within 1/4 inch of the shotcrete surface, to prevent corrosion staining of the surface.

When applying a 3/8 inch maximum aggregate size shotcrete, the Department will allow a final flash coat layer (1/4 inch to 3/4 inch thick) using 1/4 inch aggregate shotcrete.

519.3.4.2 Shotcrete Finishing

The Contractor shall leave shotcrete in the natural gun finish unless otherwise specified in the Contract.

If the Contract requires finishing, the Contractor shall cut back shotcrete to line and grade using cutting rods, screeds, or other suitable devices. The Contractor shall allow shotcrete to stiffen sufficiently before cutting and trimming, to prevent the formation of tears, cracks, and delaminations. The Contractor shall remove shooting wires on completion of cutting and trimming.

The Contractor shall apply one (1) or more of the following finishes if required:

1. Wood float finish, either as a preliminary finish for other surface treatments, or as a granular texture finish.
2. Rubber float finish, applied to either a flash coat or wood float finish, to produce a finer textured granular finish.
3. Brush finish, a fine hairbrush float finish that leaves a finely textured, sandy finish.
4. Steel trowel finish that leaves a dense, smooth hard finish.

The Contractor shall trim back shotcrete and over-spray from adjacent non-prepared concrete surfaces. The Contractor shall provide the edges of shotcrete repairs with a minimum square saw-cut edge 3/4 inch deep; finish shotcrete up to this edge. The Contractor shall not featheredge shotcrete (including flash coats).

519.3.4.3 Curing and Protection

On completion of finishing, the Contractor shall immediately prevent shotcrete from drying out by fogging or wetting.

If the Contract requires leaving shotcrete with a natural gun finish, the Contractor shall apply curing compounds at twice the application rate normally specified for smooth concrete finishes. The Contractor shall completely remove curing compounds by abrasive blasting or water blasting (with a pressure of 3,000 psi) before application of subsequent sealers.

Once the shotcrete achieves its final set, the Contractor shall keep it continuously moist for at least seven (7) Days. The Contractor shall perform moist curing using one (1) or both of the following procedures:

1. Wrap the elements in wet burlap presoaked in water for 24 h before installation;

wrap the wet burlap in plastic sheet to slow the drying rate of the burlap.

2. Install sprinklers, soaker hoses, or other devices that keep the shotcrete continuously wet. Do not use intermittent wetting procedures that allow the shotcrete to undergo cycles of wetting and drying during the curing period.

519.3.4.4 Hot and Cold Weather Protection

The Contractor shall apply shotcrete during periods of hot and cold weather in accordance with ACI 305R and ACI 306R.

If it is anticipated that shotcrete will be placed when the ambient temperature will fall below 35 °F, a Cold-Weather Shotcrete Plan must be prepared and submitted to the Project Manager at least 30 Days before the intended application. The Cold Weather Shotcreting Plan must be reviewed and approved by the State Concrete Engineer before shotcrete is permitted to be placed at temperatures below 35 °F.

The Contractor shall monitor the Surface Evaporation of the Shotcrete in accordance with Section 512, "Superstructure Concrete." The Contractor shall not proceed with shotcrete application if the average rate of surface evaporation of the shotcrete over any ten (10) minute period exceeds 0.2 lb per square foot per hour, in accordance with Section 512, "Superstructure Concrete." The Contractor shall not allow the prevailing ambient conditions (relative humidity, wind speed, air temperature, and direct exposure to sunlight) to cause either plastic shrinkage or early drying shrinkage cracking.

All cracked Structural shotcrete, regardless of the cause, shall be removed and replaced at no cost to the Department.

Subsequent efforts to prevent further cracking problems shall include, but not be limited to:

1. Rescheduling of the Work to a time when more favorable ambient conditions prevail; and
2. Adopt corrective measures, such as installation of sunscreens, windbreaks, or fogging devices to protect the Work.

During periods of cold weather, shotcreting may only proceed if the substrate to which the shotcrete is applied and the air temperature in contact with the shotcrete surfaces are both above 50 °F.

The Contractor shall maintain the air temperature in contact with the shotcrete surfaces at 60 °F or greater for at least four (4) Days after application of shotcrete. The Contractor shall submit the means of maintaining the air temperature to the Project Manager for approval. The Contractor shall not use unvented heaters.

The Contractor shall apply shotcrete at a temperature of between 50 °F and 90 °F. The Contractor shall use cooler mix temperatures during hot-weather shotcrete operations and warmer mix temperatures during cold-weather shotcrete operations.

519.3.4.5 Inspection and Remedial Work

The Contractor shall sound the surface of the cured shotcrete with a hammer to locate unsound areas.

The Contractor shall provide Equipment, hardware, and means necessary to perform the inspection operations. The inspection accommodations are subject to the approval of the

Project Manager.

The Contractor shall cut out and replace sags or other defects with another layer. If welded wire mesh reinforcement is damaged or destroyed by such repairs, the Contractor shall repair the damaged area by overlapping and tying additional wire mesh in accordance with Subsection 519.3.2.4.3, "Steel Reinforcement."

519.4 METHOD OF MEASUREMENT

The Department will measure shotcrete using the dimensions shown in the Contract or approved modifications.

519.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Structural Shotcrete</i>	Square Yard
<i>Non-structural Shotcrete</i>	Square Yard

519.5.1 Work Included in Payment

The following Work and item(s) will be considered as included in the payment for shotcrete and will not be measured or paid for separately:

1. Reinforcement;
2. Anchors;
3. Slotted pipe;
4. Ties;
5. Test molds;
6. Test samples;
7. Submittals;
8. Boring;
9. Cores; and
10. Grouting.

SECTION 520: POST-TENSIONED CONCRETE BRIDGE MEMBERS

520.1 DESCRIPTION

This Work consists of manufacturing and erecting post-tensioned concrete Bridge members composed of Portland cement concrete. Post-tensioning is tensioning in which the Contractor installs the post tension reinforcement in voids or ducts in the concrete and stresses and anchors it against the concrete after the development of the required concrete strength. As a final operation under this method, the Contractor shall pressure-grout the voids or ducts.

520.2 MATERIALS

520.2.1 Portland Cement Concrete Members

520.2.1.1 Cast-in-place Members

The Contractor shall provide cast-in-place concrete members subject to post-tensioning in accordance with Section 511, "Concrete Structures." Concrete shall be Class AA – Superstructure Concrete unless otherwise specified in the Contract.

520.2.1.2 Precast Members

The Contractor shall provide precast concrete members subject to post-tensioning in accordance with Section 517, "Precast Concrete Structures."

520.2.1.3 Prestressed Members

The Contractor shall provide prestressed concrete members subject to post-tensioning in accordance with Section 518, "Pre-stressed Concrete Members."

520.2.2 Post Tension Reinforcement

Post tension reinforcement consists of high strength steel wire, high strength seven-wire steel strands, or uncoated high strength steel bars, in accordance with the Contract. The Contractor shall provide post tension reinforcement that is clean, and free of dirt, loose rust, or other Deleterious Material when placed in the member.

520.2.2.1 High-Strength Wire

The Contractor shall provide high-strength steel wire in accordance with AASHTO M 204.

520.2.2.2 High-Strength Multiple-Wire Steel Strand

The Contractor shall provide high-strength multiple-wire steel strands in accordance with AASHTO M 203M, Supplement S1 (low-relaxation), unless otherwise specified.

520.2.2.3 Uncoated High-Strength Steel Bars

The Contractor shall provide uncoated high-strength steel bars in accordance with AASHTO M 275. If the Department allows bars with a greater minimum ultimate strength, the Contractor shall produce and test them in accordance with AASHTO M 275.

520.2.2.4 Identification of Post tension Reinforcement

The Contractor shall assign post tension reinforcement and anchorage assemblies with a lot number and tag for identification purposes. The Department will reject high-strength Materials lacking identification.

520.2.2.5 Sampling of Post tension Reinforcement

The Contractor shall submit load elongation curves and mechanical properties representative of the strands or bars to the Project Manager. The Contractor shall submit certified test results in accordance with AASHTO 203.

520.2.2.6 Protection of Post tension Reinforcement

The Contractor shall protect post tension reinforcement against physical damage, rust or other results of corrosion, from manufacture to grouting. The Project Manager will reject post tension reinforcement that is physically damaged.

520.2.3 Ducts

The Contractor shall use duct enclosures for post tension reinforcement that are mortar tight. Aluminum ducts will not be permitted.

520.2.4 Anchorage Devices

The Contractor shall secure post-tension reinforcement at the ends by means of approved permanent anchoring devices. The Contractor shall design anchorage devices to hold the post tension reinforcement at a load producing a stress of at least 95% of the post tension reinforcement's guaranteed minimum tensile strength. The Contractor shall distribute the load from the anchoring device to the concrete with approved devices.

The Contractor shall provide anchorage devices in accordance with the following requirements:

1. Do not allow the average bearing stresses on the concrete created by the anchorage distribution plates to exceed the values specified in the current AASHTO *LRFD Bridge Design Specification*.
2. Do not allow bending stresses in the plates or assemblies induced by the pull of the post tensioning to exceed the Material yield point, or cause visible distortion in the anchorage plate when 100% of the ultimate load is applied.

The Contractor may omit the steel distribution plates or assemblies if the compressive stresses to the concrete are effectively distributed with anchoring devices in conjunction with a steel grillage embedded in the concrete.

520.2.5 Grout

The Contractor shall provide pre-packaged grout with minimum 28-day compressive strength of 6000 psi. The Contractor shall use grout specifically manufactured for grouting of post-tensioning ducts, and approved by the Project Manager prior to use.

520.3 CONSTRUCTION REQUIREMENTS

520.3.1 General

The Contractor shall use members manufactured in an approved established commercial precast facility, unless the Contract specifies that members may be cast-in-place. The Project

Manager must approve the method of post-tensioning of concrete before incorporating it into the Work.

The Contractor shall have a representative certified by the Post-Tensioning Institute (PTI) as a Level 1 Unbonded PT – Field Installer to provide direct oversight of the crew performing the post-tensioning Work. The Contract will specify the required jacking force, anchor set, and coefficient of initial post tension.

520.3.1.1 Post-Tensioning Plan and Grouting Plan Submittal

The Contractor shall provide a post-tensioning plan that shall include complete details and calculations prepared by a licensed New Mexico Professional Engineer supporting the methods, sequence of stressing, Materials, and Equipment to use in the post tensioning operations. The Contractor shall submit this to the Project Manager at least 30 Days before incorporating it into the Work.

The Contractor shall ensure the details completely describe the proposed post tensioning system, including the following:

1. Type and arrangement of post tension reinforcement;
2. Complete Specifications and details of post tension reinforcement;
3. Anchorage devices;
4. Anticipated elongations and base calculations for the nominal area;
5. Forms for cored holes and voids;
6. Ducts for the enclosure of post tension reinforcement;
7. Any additions or rearrangement of reinforcing steel from that shown in the Contract;
8. Sequence of post tensioning;
9. Certification of Equipment calibration;
10. For the operation of grouting post tension reinforcement - the Materials and proportions for grout, details of equipment for mixing and placing grout, and methods of mixing and placing grout (also, locations and details of inlets and outlets for grouting and the direction of grouting); and
11. Other data pertaining to the post tensioning operations.

520.3.1.2 Approval of Post-Tensioning Equipment

The Project Manager must approve Equipment for post-tensioning concrete members before the Contractor starts the Post-tensioned post tensioned concrete Work. The Project Manager may reject unsatisfactory machinery, Equipment, or appurtenances.

The Equipment shall be calibrated with a load cell and provided with an indicator to determine the force in the post tension reinforcement. The Contractor shall use a load cell range that does not include the lower ten percent (10%) of the Fabricator's rated capacity to determine the jacking stress.

The Contractor shall use an independent testing Laboratory approved by the Project Manager to calibrate the Equipment. The Contractor shall ensure that the Equipment has been calibrated within a year of the Work. The Project Manager shall check certified calibration charts for the hydraulic jacks, pressure gages, or load cells used for tensioning post tension reinforcement before and during post tensioning operations.

520.3.1.3 Placement of Reinforcing Bars, Post tensioning Ducts, and Appurtenances

The Contractor shall place and secure reinforcing bars, ducts for enclosing post tension reinforcement, forms for cored holes, and cellular spaces with methods approved by the Project Manager. The Contractor shall pay particular attention to concrete cover requirements over reinforcing bars near and at ends of beams.

520.3.2 Ducts

520.3.2.1 Formed Ducts

The Contractor shall provide ducts that allow the entrances of grout. The Contractor shall use a duct that will transfer bond stresses as required and will retain its shape under the weight of the concrete.

520.3.2.2 Grout Opening or Vents

The Contractor shall provide ducts with grout openings in locations to ensure air is not trapped in the ducts. The Contractor shall provide grout openings or vents with provisions for preventing grout leakage.

520.3.2.3 Placement of Ducts

After placing the ducts and completing reinforcement and forming, the Contractor shall inspect the Work for possible duct damage. The Contractor shall securely fasten ducts at close intervals to avoid displacement during concrete placement. The Contractor shall repair unintentional holes or openings in the duct before concrete placement as approved by the Project Manager.

The Contractor shall securely anchor grout openings and vents to the duct and to the forms or reinforcing steel to prevent displacement during concrete placement.

After installation in the forms, the Contractor shall cover the ends of ducts as necessary to prevent water or debris from entering. The Contractor shall ensure the vents are mortar tight and provide means for injecting grout through the vents and sealing the vents. The Contractor shall remove the ends of vents two (2) inches below the Roadway surface after completing grouting.

520.3.3 Tensioning

The Contractor shall apply tension to post tension reinforcement with hydraulic jacks to produce forces in accordance with the approved post tensioning procedure (reference Section 520.3.1.1, "Post-Tensioning Plan and Grouting Plan Submittal").

During strand stressing, the Project Manager may accept individual wire failures, if no more than one (1) wire in any strand is broken and the area of broken wires does not exceed two percent (2%) of the total area of the post tensioning steel in the member.

The Contractor shall stress the members in a sequence that produces minimal eccentric forces.

520.3.3.1 Tensioning Equipment

The Contractor shall apply stress to tendons using hydraulic jacks that can provide and sustain the necessary forces and have either a pressure gauge or a load cell for determining jacking stresses.

The Contractor shall use a pressure gauge with at least a six (6) inch diameter dial accompanied with a certified calibration chart. The Contractor shall calibrate each jack and its gauge as a unit with the cylinder extension in the approximate position that it will be at final jacking force.

520.3.3.2 Measurement of Stress

The Contractor shall provide a record of gauge pressures and tendon elongations for each tendon, for review and approval by the Project Manager. The Contractor shall measure elongations to an accuracy of within 1/16 inch. The Contractor shall not cut off stressing tails of post-tensioned tendons until the Project Manager approves the stressing records.

The Contractor shall use the gauge or load cell readings to determine the stress in the tendons during tensioning and verify with the measured elongations.

The Contractor shall use the modulus of elasticity to calculate anticipated elongations and base calculations for the nominal area (provided by the Fabricator per lot of tensioned steel), or as determined by a bench test of strands used in the Work.

Before starting elongation readings, the Contractor shall tension the tendons to a preliminary force to eliminate take-up in the tensioning system. The Contractor shall ensure this preliminary force is between five percent (5%) and 25% of the final jacking force. The Contractor shall measure the initial force with a dynamometer or with other approved methods. The Contractor shall mark each strand before the final stressing to permit measurement of elongation and to ensure that anchor wedges are set properly.

The Contractor shall address a discrepancy in indicated stress between jack gauge pressure and elongation. If this occurs, the load used, as indicated by the gauge pressure, will produce a slight overstress rather than understress. The Contractor shall check the entire operation to determine the source of errors, if a discrepancy occurs between gauge pressure and elongation; more than five percent (5%) for tendons longer than 50 ft, or seven percent (7%) for tendons shorter than 50 ft. The Contractor shall correct errors before proceeding.

520.3.3.3 Tensioning Post-Tensioned Members

The Contractor shall not post tension cast-in-place concrete until at least ten (10) Days after placing the last concrete in the member and until the compressive strength of the concrete has reached the 75% of the specified strength. The Contractor shall use the methods described in Section 510.3.5.2, "In-Place Concrete Strength Measurements" to determine the actual in-place compressive strength of the concrete.

The Contractor shall perform the tensioning of post tension reinforcement in the members so that the Project Manager may continuously observe the tension applied and the elongation of the post tension reinforcement.

The Contractor shall apply tensioning forces to post tension reinforcement in the sequence and amount approved by the Project Manager to avoid excessive eccentric loads about the vertical axis of the member.

The Department will not allow the maximum temporary stress (jacking stress) and the stress in the steel before losses due to creep and shrinkage to exceed the values in accordance with Section 5 of the AASHTO's *LRFD Bridge Design Specification*.

520.3.4 Grouting Post tension Reinforcement in Post-Tensioned Members

The Contractor shall bond the post tension reinforcement to the ducts 24 hours after completing tensioning and anchoring of the post tension reinforcement.

If the end of a post-tensioned assembly will not be covered by concrete, the Contractor shall recess the anchoring devices so that the ends of the post tension reinforcement and the anchoring devices are at least two (2) inches inside of the end surface of the members, unless the Contract requires a greater embedment. Patch Material shall be in accordance with Section 533, "Concrete Structure Repair."

520.3.5 Grouting Keyways in Precast Members Subject to Post-Tensioning

The Contractor shall use fibrous Material that retains grout but does not intrude into the keyway openings.

The Contractor shall inspect keyway joints in precast box girders immediately before placing grout. The Contractor shall keep the keyways clear of Material, and keep interior surfaces clean and moist. The Contractor shall place and consolidate the non-shrink grout into the joint so that it fills the keyway to the deck surface. The Contractor shall strike off the grout at the deck surface.

The Contractor shall cure in accordance with Section 511, "Concrete Structures."

520.4 METHOD OF MEASUREMENT

The Department will measure concrete for cast-in-place post-tensioned members in accordance with Section 511, "Concrete Structures," or Section 512, "Superstructure Concrete." The Department will measure reinforcing steel for cast-in-place post-tensioned members in accordance with Section 540, "Steel Reinforcement."

The Department will measure quantities for precast members subject to post-tensioning in accordance with Section 517, "Precast Concrete Structures" or Section 518, "Pre-stressed Concrete Members."

520.5 BASIS OF PAYMENT

Pay Item

Pay Unit

Post Tensioning

Lump Sum

520.5.1 Work Included In Payment

The following items will be considered as included in the payment for the main item(s) will and not be measured or paid for separately:

1. Post tension reinforcement in post-tensioned members; and
2. Ducts, anchorage devices, distribution plates or assemblies, grouting recesses and ducts, and all other incidental parts and processes required for post-tensioned members.

SECTION 521: NON-SHRINK GROUT

521.1 DESCRIPTION

This Work consists of providing and placing non-shrink grout for use in concrete Structures. Uses of grout include the following:

1. Filling under masonry plates and blockouts between precast members;
2. Bonding cementitious dowel bars in preformed recesses;
3. Filling shear keys between Bridge members; and
4. Other uses as required.

For Concrete Structure surface repairs, see Section 533, "Concrete Structure Repair."

521.2 MATERIALS

The Contractor shall provide prepackaged nonshrink hydraulic-cement grout ("grout") in accordance with Table 521.2:1, "Enriched Mortar Physical Property Requirements." The Contractor shall select the grout from the Department's *Approved Products List*. The grout shall be nonmetallic, water-based and cannot contain chlorides, fluorides, sulfites, nitrates, or gas-forming agents.

**Table 521.2:1
Enriched Mortar Physical Property Requirements**

Property	ASTM Test	Requirements
Compressive strength, minimum (psi)	C-1107	Stiff
		3 day - 4000
		7 day - 5000
		28 day - 8000
		Flowable
		3 day - 3000
Hardened Grout Height Change	C-827	7 day - 3500
		28 day - 5000
		Maximum 0.6%
Pull-out Strength	E-488	20,000 lbf

The Contractor shall provide water in accordance with Section 509.2.6, "Water."

521.3 CONSTRUCTION REQUIREMENTS

The Contractor shall use non-shrink grout in accordance with the manufacturer's recommendations and instructions regarding proportioning, mixing, maximum water content, application, curing temperatures, and curing conditions. If manufacturer's recommendations conflict with this Section, the manufacturer's recommendations shall govern.

521.3.1 Placing, Finishing, and Curing

The Contractor shall clean concrete areas of loose or Deleterious Material that would prevent a bond between the grout and the base concrete surfaces. The Contractor shall flush

areas with water and let dry to a surface dry condition immediately before placing the grout.

The Contractor shall ensure that the grout completely fills recesses and holes, voids under structural members, and at other specified locations. The Contractor shall screed the Material to the specified level, and finish the surface to the specified texture.

521.3.2 Curing

After placing, the Contractor shall cure surfaces of grout in accordance with the manufacturer's recommendations. If the manufacturer recommendations are not specific, cure surfaces in accordance with Section 511.3.9.1, "Method 1, Water Curing."

521.3.2.1 Temperature Requirements

The Contractor shall place grout when the air temperature is at least 45 °F, but less than 95 °F. The Contractor shall not allow the grout temperature to rise above 85 °F during mixing and placing.

The Contractor shall maintain the temperature of the grout at or above 45 °F during the curing period.

521.3.3 Elapsed Time Before Loading

The Contractor shall not allow loads on grout that has been in place less than 72 hours, or as recommended by the manufacturer, unless otherwise directed by the Project Manager.

521.3.4 Grout Defects

The Contractor shall remove and replace improperly cured or otherwise defective grout.

521.4 METHOD OF MEASUREMENT - Reserved

521.5 BASIS OF PAYMENT

521.5.1 Work Included In Payment

The Department considers providing, placing, and curing of non-shrink grout incidental to the completion of the Work and will not measure or pay for it separately.

SECTION 522: CHEMICAL ADHESIVE ANCHORS

522.1 DESCRIPTION

This Work consists of providing chemical adhesive anchorage systems.

522.2 MATERIALS

The Contractor shall use chemical adhesive anchorage for the installation of steel anchors in concrete Structures.

522.2.1 Chemical Adhesive Anchor Devices

The Contractor shall select chemical adhesive anchor devices from the Department's *Approved Products List*. The Contractor shall notify the Project Manager of the selection at least 21 Days before using the devices on a Project.

The Contractor shall provide devices in accordance with Table 522.2.1:1, "Chemical Adhesive Anchor System Ultimate Tension Load Requirements." The Contractor shall use chemical adhesives of organic and inorganic compounds (including epoxies, polyurethanes, methacrylates and vinyl esters) to develop bond to concrete.

**Table 522.2.1:1
Chemical Adhesive Anchor System Ultimate Tension Load Requirements**

Anchorage bolt diameter (inch) or bar size	Minimum ultimate tension load (pounds) per ASTM E488
One (1) inch	37,700
7/8 inch	28,900
3/4 inch	21,200
5/8 inch	14,700
1/2 inch	9,400
3/8 inch	5,300
1/4 inch	2,400
No. 6	21,200
No. 5	14,700
No. 4	9,400

(Based on ASTM A307 anchor, Grade 60 rebar and 3,000 psi concrete)

522.2.1.1 Hardware

The Contractor shall provide ASTM A 307 Grade A threaded rod with nut (ASTM A 563A Hex) and washer (ASTM F 844) or ASTM A 193 Grade B7 threaded rod with nut (ASTM A 194 Grade 2H) and washer (ASTM F 436). The thread rod, nut and washer shall be zinc coated per AASHTO M 298, Class 50 (ASTM B 695, Class 50). If stainless steel anchor is specified in the contract, the Contractor shall provide ASTM F 593 threaded rod with nut (ASTM F 594) and washer (ASTM A 240).

The Contractor shall provide Grade 60 deformed steel bar reinforcements in accordance with AASHTO M 31.

The Department will not accept metal wedge expansion-type anchors as substitutes for

chemical anchors.

522.2.1.2 Materials Certification

The Contractor shall submit a sample of the concrete chemical anchor device along with the manufacturer's installation instructions to the Project Manager.

The Contractor shall submit independent certified test results for expansion anchors in accordance with ASTM E 488 to the Project Manager. The Contractor shall submit independent certified test results for adhesive-bonded and other bonding compounds in accordance with ASTM E 1512 to the Project Manager. The Contractor shall use ASTM A 307 Grade A steel for anchor bolts (rods), Grade 60 steel reinforcing bars, and 3,000 psi concrete for these independent certified tests.

The Contractor shall test chemical adhesive anchor device systems installed per manufacturer's recommendations.

The Contractor shall provide independent test results to certify that the average ultimate tension load strength and method of installation of the proposed concrete anchorage system are in accordance with Table 522.2.1:1, "Chemical Adhesive Anchor System Ultimate Tension Load Requirements."

522.3 CONSTRUCTION REQUIREMENTS

The Contractor shall prepare holes and installation of the chemical adhesive anchors in accordance with the manufacturer's recommendations and instructions, including weather and temperature limitations. The Contractor shall not install chemical adhesive anchor systems before concrete attains its design strength.

522.3.1 Drilling of Holes

The Contractor shall use drilling methods that do not cause concrete spalling or cracking, or damage to the main reinforcing steel members. The Contractor shall drill the diameter and depth of the holes in accordance with the chemical adhesive anchor manufacturer's instructions, using drilling methods and drill bits specifically intended by the manufacturer for the particular anchorage. Diamond core drilling of the holes is not permitted unless allowable by the manufacturer.

The Contractor shall repair spalled or damaged concrete as directed by the Project Manager.

The Contractor shall not drill with a lubricant; water is not a lubricant.

The Contractor shall maintain a distance of at least two (2) inches from the bottom of the structural slab to the bottom of drill holes. The Contractor shall only use anchor systems that can maintain this minimum surface-to-drill-hole distance requirement and still meet certified strength requirements.

522.3.2 Hole Preparation

Hole preparation shall be in accordance with the Manufacturer's recommendations. . The Contractor shall ensure holes are dry before installing anchors. :

522.3.3 Finishing

After the Contractor inserts the anchor into the full depth of the drilled hole, the Contractor shall strike flush the excess adhesive with the concrete surface. After placing the anchors, the Contractor shall not move anchors and shall not load the anchors until adhesives are fully cured.

522.3.4 Field Proof Load Tests

The Contractor shall submit the testing method to the State Materials Bureau before beginning the field pullout tests. The Contractor shall use an applied test load for the chemical adhesive anchors field pullout tests in accordance with Table 522.3.5:1, "Chemical Adhesive Anchor Design Loads."

The Contractor shall perform proof load tests only if the Contract requires. The NMDOT may perform proof load tests at NMDOT discretion. If the Contract requires proof load tests, the Contractor shall use nondestructive loading and stop the tests when the design tensile forces have been sustained for at least three (3) minutes without creep or deflection.

The Contractor shall use anchors that attain the specified test loads without permanently displacing the anchor or damaging the concrete. The Contractor shall replace anchor devices that fail the load test. The Contractor shall test replaced anchors.

The Contractor shall repair spalled or damaged concrete from load tests as directed by the Project Manager. In the event that proof load tests fail to meet requirements, the Contractor shall submit a corrective action plan for deficiencies.

522.3.4.1 Acceptance

The Department will accept anchor if the specified test load is attained without permanently displacing the anchor or damaging the concrete.

522.3.4.2 Field Test Procedure

If the Contract requires proof load tests, the Project Manager will designate a random portion of not less than five percent (5%) of the installed concrete chemical anchors for load testing. The Contractor shall perform load tests in accordance with ASTM E 488 for static testing. If any individual test fails, the Contractor shall test all anchors for compliance with Table 522.3.5:1, "Chemical Adhesive Anchor Design Loads."

522.3.5 Design Loads

The Contractor shall ensure chemical adhesive anchor systems are in accordance with Table 522.3.5:1, "Chemical Adhesive Anchor Design Loads."

**Table 522.3.5:1
Chemical Adhesive Anchor Design (Proof) Loads**

Anchorage bolt diameter (inch) or bar size	Design load and tensile test load (pounds) per ASTM E488
One (1) inch	9,425
7/8 inch	7,225
3/4 inch	5,300
5/8 inch	3,675
1/2 inch	2,350
3/8 inch	1,325

**Table 522.3.5:1
Chemical Adhesive Anchor Design (Proof) Loads**

Anchorage bolt diameter (inch) or bar size	Design load and tensile test load (pounds) per ASTM E488
1/4 inch	600
No. 6	5,300
No. 5	3,675
No. 4	2,350

522.3.6 Welding

Welding to post-installed anchors is not permitted.

522.4 METHOD OF MEASUREMENT—Reserved

522.5 BASIS OF PAYMENT

The Department will make no separate payment for this Work, unless otherwise specified in the Contract.

522.5.1 Work Included In Payment

The Department considers all labor and Materials for the preparation of holes and installation of dowels and anchors incidental to the completion of the Work and will not make separate payment.

SECTION 523: CEMENTITIOUS-GROUTED DOWELS AND ANCHORS

523.1 DESCRIPTION

This Work consists of providing and placing cementitious-grouted dowels and anchors for concrete Structures.

523.2 MATERIALS

Unless otherwise specified in the Contract, the Contractor shall use chemical adhesive anchorage per Section 522, "Chemical Adhesive Anchors" for the installation of steel anchors in concrete Structures. Cementitious grouted dowels and anchors shall only be used when required by the Contract.

523.2.1 Grout

The Contractor shall provide grout in accordance with Section 521, "Non-Shrink Grout."

The Contractor shall provide preblended mortar (grout), in accordance with the manufacturer's recommendations and instructions regarding proportioning, mixing, maximum water content, application, and curing temperatures and conditions.

523.2.2 Threaded Rods or Deformed Anchor Bars

Unless otherwise specified in the Contract, the Contractor shall fabricate dowels and anchors from full length threaded steel rods in accordance with ASTM A 307 or better, or deformed steel reinforcing bars in accordance with AASHTO M 31, Grade 60.

523.3 CONSTRUCTION REQUIREMENTS

523.3.1 Design (Proof) Loads

Unless otherwise shown in the Contract, the Contractor shall provide design tensile (pullout) loads for anchors or dowels fabricated from full length threaded steel bars or Grade 60 reinforcing bars in accordance with Table 523.3.1:1, "Cementitious-Grouted Dowels and Anchors Design (Proof) Loads."

**Table 523.3.1:1
Cementitious-Grouted Dowels and Anchors Design (Proof) Loads**

Reinforcing bar size or threaded rod diameter	Design tensile load for cementitious grout (lb)
No. 8	5230
No. 7	4000
No. 6	2930
No. 5	2030
No. 4	1300
One (1) inch	4700
7/8 inch	3600
3/4 inch	2630
5/8 inch	1830
1/2 inch	1170

523.3.1.1 Field Proof Load Tests

The Contractor shall submit the testing method to the State Materials Bureau before beginning the field pullout tests. The Contractor shall use an applied test load for the anchors field pullout tests in accordance with Table 523.3.1:1, "Cementitious-Grouted Dowels and Anchors Design (Proof) Loads."

The Contractor shall perform proof load tests only if the Contract requires. The NMDOT may perform proof load tests at NMDOT discretion. If the Contract requires proof load tests, the Contractor shall use nondestructive loading and stop the tests when the design tensile forces have been sustained for at least three (3) minutes without creep or deflection.

The Contractor shall use anchors that attain the specified test loads without permanently displacing the anchor or damaging the concrete. The Contractor shall replace anchor devices that fail the load test. The Contractor shall test replaced anchors.

The Contractor shall repair spalled or damaged concrete from load tests as directed by the Project Manager. In the event that proof load tests fail to meet requirements, the Contractor shall submit a corrective action plan for deficiencies.

523.3.2 Embedment Depth

The Contractor shall provide the required embedment depth as shown in the Contract Drawings.

The Contractor shall maintain a distance of 1 1/2 inch or greater from the bottom of structural deck slabs and two (2) inches or greater from the face of Structures in other installations.

The Contractor shall only use anchor systems that can maintain this minimum surface to drill hole distance requirement and still meet certified strength requirements.

523.3.3 Hole Preparation

The Contractor shall use impact drills equipped with carbide tipped bits or core drill. The Contractor shall not spall or damage concrete adjacent to the holes.

The Contractor shall provide a drilled hole diameter 3/4 inch greater than the diameter of steel anchors and dowels. Diamond core drilling of the holes is not permitted. The Contractor shall clean holes of dust, drilling debris, and other Deleterious Materials, saturate holes with water, and remove free water before placing the dowels or anchors.

The Contractor shall not drill with a lubricant; water is not a lubricant.

523.3.4 Placing of Anchors and Mortar (Grout)

The Contractor shall use sufficient mortar (grout) so no voids remain between the anchors and the sides of the holes after the dowels or anchors are fully inserted. During and after placing of the dowels and anchors, the Contractor shall maintain a tight bond between the mortar (grout) and hole and between the mortar (grout) and anchor or dowel.

523.3.5 Curing

Curing shall be in accordance with Section 521, "Non-Shrink Grout."

523.3.6 Temperature Limitations

Temperature limitations shall be in accordance with Section 521, "Non-Shrink Grout."

523.3.7 Damaged or Unbonded Dowels and Anchors

The Contractor shall remove and replace dowels and anchors that fail to bond or are damaged before placing new concrete or completing the Structure.

523.4 METHOD OF MEASUREMENT—Reserved

523.5 BASIS OF PAYMENT

523.5.1 Work Included In Payment

The Department considers all labor and Materials for the preparation of holes and grouting of dowels and anchors incidental to the completion of the Work and will not make separate payment.

SECTION 529: PIER AND ABUTMENT BEARING MODIFICATION

529.1 DESCRIPTION

This Work shall consist of raising Superstructure members and modifying bearing units in substantial compliance with the pertinent portions of the Standard Specifications and the details shown on the Plans or as directed by the Project Manager.

529.2 MATERIALS

All Materials incorporated permanently into the Work shall meet the requirements as shown on the Plans.

529.3 CONSTRUCTION REQUIREMENTS

Load-carrying Superstructure members shall be slightly raised and temporarily supported by methods approved by the Project Manager to permit modifications to be made to the designated bearing units. Unless the existing concrete deck has been removed, all beams or girders in a span shall be simultaneously raised an equal vertical distance and supported.

Bearing modifications shall be performed in a manner that will not damage any members being retained in the structure. The Project Manager shall approve proposed steel cutting and weld removal methods.

When shown on the Plans, traffic will be permitted to operate on the Bridge or Bridges during these operations.

Unless otherwise provided, painted area damaged by the Work shall be cleaned and repainted as provided in Section 546, "Recoating Structures" and Section 547, "Safety and Environmental Requirements for Paint Operations." No payment will be made for recoating damaged areas.

The Contractor shall submit Working Drawings, design calculations, and jacking procedures to the Project Manager for Acceptance. Design of jacking and shoring shall be in accordance with the AASHTO Guide Design Specifications for Bridge Temporary Works. In the event of a conflict between the referenced Guide and this specification, this specification will take precedence. The Contractor shall submit at least 30 Days before Work is planned to begin. Any resubmittal will require an additional 14 Days for review. The submittal package shall be stamped by a NM Licensed Professional Engineer with a minimum of five (5) years of structural design and Construction experience.

Construction of the lateral bracing system shall be in accordance with the AASHTO Construction Handbook for Bridge Temporary Works. In the event of a conflict between the referenced Handbook and this specification, this specification will take precedence.

529.4 METHOD OF MEASUREMENT

Pier and abutment bearing modifications shall be measured as a completed unit, including Incidental Work, any temporary support required, submittal, and any Materials incorporated into the Work, unless noted otherwise on the Plans.

529.5 BASIS OF PAYMENT

Pay Item	Pay Unit
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529.5.1 Work Included In Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Repair of concrete or Bridge elements damaged by the Contractor's operation.
2. Cleaning and repainting areas damaged by the Contractor's operation.

SECTION 531: PERMANENT ANTI-GRAFFITI PROTECTIVE COATING

531.1 DESCRIPTION

This Work shall consist of providing and applying anti-graffiti coating to concrete and steel surfaces at the location(s) shown in the Contract.

531.2 MATERIALS

Use a permanent (non-sacrificial) anti-graffiti coating.

Provide a treatment solution that is on the Department's Approved Products List.

531.2.1 Physical Properties

Product shall meet the requirements for ASTM D7089 Cleanability Level 1 – graffiti removal with pressure water wash. Product shall meet the requirements of ASTM D6578 – Standard Practice for Determination of Graffiti Resistance.

The color shall be clear and shall not alter the color of the underlying surface finish.

531.2.2 Submittals

Submit documentation showing the manufacturer's application instructions and recommended coverage rates.

Submit project specific letter from the manufacturer confirming compatibility with underlying surface coatings including but not limited to: concrete curing compound, penetrating water repellent treatment, primer, or paint products. A letter is not required if the material is applied over bare concrete or bare steel.

The Contractor shall allow 14 Days for submittal review.

531.3 CONSTRUCTION REQUIREMENTS

Permanent anti-graffiti protective coating shall be applied to concrete and steel surfaces after completion of the coating for concrete surfaces or topcoat for steel surfaces. The Contractor shall apply the protective coating in compliance with all manufacturer's recommendations. The type of protective coating and method of application must be approved by the Project Manager prior to use. The Contractor shall furnish all Materials, storage, handling, tools, Equipment, labor, and other appurtenances necessary to complete the Work.

531.4 METHOD OF MEASUREMENT

Permanent anti-graffiti protective coating will be measured by the square foot.

531.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Permanent Anti-Graffiti Protective Coating</i>	Square Foot

531.5.1 Work Included In Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Surface preparation per manufacturer's recommendations.

SECTION 532: PENETRATING WATER REPELLENT TREATMENT

532.1 DESCRIPTION

This Work consists of providing and applying a penetrating water repellent treatment to concrete surfaces. See 511.3.10, "Penetrating Water Repellent Treatment Solution" for required application locations.

532.2 MATERIALS

The Contractor shall use a penetrating water repellent solution that has a minimum of 40% solution by weight of silane or alkyltrialkoxo silane.

The Contractor shall use a solution that does not stain, discolor, alter the texture of, or form a coating on the concrete surface. The Contractor shall use a solution that is compatible with surface finishes applied in accordance with Section 511.3.8.5, "Class 4, Special Surface Finish" and Section 548, "Coating of Concrete."

The Contractor shall provide a treatment solution that is on the Department's Approved Products List.

532.2.1 Physical Requirements

The Contractor shall provide a penetrating water repellent solution in accordance with Table 532.2.1:1, "Penetrating Water Repellent Treatment Requirements."

**Table 532.2.1:1
Penetrating Water Repellent Treatment Requirements**

Characteristic	Requirement	Test method
Reduction in moisture absorption	80% minimum	NCHRP #244 Series II or ASTM D6532
Reduction in chloride ion absorption	80% minimum	NCHRP #244 Series II

532.2.2 Submittals

The Contractor shall submit manufacturer's product data and application instructions to the Project Manager 14 Days prior to start of work.

The Project Manager may take samples of the Materials from the shipping containers at the job site.

532.3 CONSTRUCTION REQUIREMENTS

532.3.1 Surface Preparation

Before applying the treatment solution, the Contractor shall remove curing compounds, laitance, dirt, dust, salt, oil, asphalt, and other Deleterious Materials from the concrete surface.

The Contractor shall obtain approval for surface preparation Equipment from the Project Manager.

The Contractor shall ensure that the cleaning process:

1. Does not damage the concrete surface;
2. Does not remove or substantially alter the existing surface finish;
3. Does not expose coarse aggregate in the existing concrete; and
4. Provides a reasonably uniform surface color and texture.

Validation for surface preparation shall be performed by applying adhesive tape to the surface. When the tape is removed there shall be no laitance or debris adhered to the tape.

The Contractor shall apply the treatment solution only after obtaining approval of the cleaned surfaces from the Project Manager.

532.3.2 Application of Treatment Solution

532.3.2.1 Temperature and Weather Limitations

The Contractor shall apply the treatment solution only when the air and concrete surface temperatures are between 40 °F and 100 °F, unless more restrictive temperature limits are recommended by the manufacturer. The Contractor shall not apply the solution to concrete surfaces when the wind speed is greater than ten (10) mph.

532.3.2.2 Application Equipment

The Contractor shall use Equipment that can apply the solution to all surfaces until they are all saturated and no further solution can be absorbed. The Contractor shall obtain written approval of the Equipment used from the Project Manager before starting application Work.

532.3.2.3 Application

The Contractor shall not treat new concrete until it attains the specified design strength. The Contractor shall follow the manufacturer's recommendations for application.

The Contractor shall not dilute or alter the treatment solution as supplied by the manufacturer.

The Contractor shall follow the manufacturer's recommended rate of coverage when applying the solution but not less than full saturation and no further solution can be absorbed.

The Contractor shall lightly apply water to treated surfaces between 12 h and four (4) Days after treatment to verify coverage where directed by the Project Manager.

If the Contract specifies both a water repellent treatment and a special surface finish, the Contractor shall refer to the manufacturer's application recommendation on order of application.

532.3.3 Traffic Limitations

The Project Manager will determine when traffic is allowed on treated surfaces.

532.4 METHOD OF MEASUREMENT

Penetrating water repellent treatment of existing concrete surface areas will be paid for at the contract unit price per square yard.

532.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Penetrating Water Repellent Treatment</i>	Square Yard

532.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following:

1. Penetrating Water Repellent Treatment applied to surfaces of new concrete structures will be considered as included in the payment for the main items and will not be paid for separately.
2. Penetrating Water Repellent Treatment applied to repaired concrete surfaces will be considered as included in the payment for the main items and will not be paid for separately.

SECTION 533: CONCRETE STRUCTURE REPAIR

533.1 DESCRIPTION

This Work consists of the following:

1. Establishing repair areas;
2. Removing loose, unsound, and deteriorated concrete;
3. Preparing and cleaning concrete surfaces;
4. Removing and replacing or supplementing compromised reinforcing bars; and
5. Furnishing, placing, finishing, and curing concrete repair Materials.

533.2 MATERIALS

533.2.1 Concrete Repair Material (referred to as “Concrete” or “Repair Material”)

The Contractor shall use enriched mortar where the repair depth is less than one (1) inch, and use enriched concrete where the repair depth is one (1) inch or greater, unless otherwise directed by the manufacturer. If the repair depth is four (4) inches or greater, the Contractor shall use enriched concrete or the appropriate class concrete per Section 509, “Portland Cement Concrete Mix Designs.” Concrete repair Material may optionally be pre-packaged rapid-hardening cementitious Materials or two (2)-part epoxy and aggregate repair Material.

When using enriched mortar, enriched concrete, or rapid-hardening cementitious Material, the Contractor may use concrete mixtures developed and approved in accordance with Section 509, “Portland Cement Concrete Mix Designs” or pre-packaged, pre-blended cementitious Materials in accordance with this Section, that are combined with water at the site.

Manufacturer’s certified strength tests shall be Accepted instead of tests by the State Materials Bureau. Testing may be performed by the State Materials Bureau at any time. Tests by the State Materials Bureau shall supersede manufacturer’s certified tests.

533.2.1.1 Enriched Mortar

**Table 533.2.1.1:1
Enriched Mortar Physical Property Requirements**

Property	ASTM Test	Requirements
Compressive strength, minimum	C-109	One (1) Day: 2,700 psi
		Seven (7) Days: 3,200 psi
		28 Days: 4,500 psi
Bond strength, minimum	C-882	One (1) Day: 1,000 psi
		Seven (7) Days: 2,000 psi
		28 Days: 3,000 psi
Linear length change, Maximum	C-157	28 Days wet: +0.05 % ^a
		28 Days dry: -0.05 %
Coefficient of thermal expansion (in/in/°F)	C-531	3.9 x 10 ⁻⁶ to 7.1 x 10 ⁻⁶

Table 533.2.1.1:1
Enriched Mortar Physical Property Requirements

Freeze/thaw resistance @ 300 cycles, minimum	C-666	Per Section 509.2.8.4.2, Note 3
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^aThe maximum allowable expansion is 0.4% if the locations where enriched mortar is used can tolerate such expansions without exceeding the elastic limit.

The Contractor shall provide enriched mortar that consists of a blended patching Material and water. The Contractor shall provide enriched mortar with physical properties in accordance with Table 533.2.1.1:1, "Enriched Mortar Physical Property Requirements."

533.2.1.2 Enriched Concrete

The Contractor shall provide enriched concrete consisting of enriched mortar extended with recommended amounts of coarse aggregate. The Contractor shall provide enriched concrete with physical properties in accordance with Table 533.2.1.2:1, "Enriched Concrete Physical Property Requirements."

Table 533.2.1.2:1
Enriched Concrete Physical Property Requirements

Property	ASTM Test	Requirements
Compressive strength, minimum	C-39	One (1) Day: 2,500 psi
		Seven (7) Days: 3,000 psi
		28 Days: 4,000 psi
Bond strength, minimum	C-882	One (1) Day: 900 psi
		Seven (7) Days: 1,800 psi
		28 Days: 2,200 psi
Linear length change (%), maximum	C-157	28 Days wet: +0.04 % ^a
		28 Days dry: -0.04 %
Coefficient of thermal expansion (in/in/°F)	C-531	3.9 x 10 ⁻⁶ to 7.1 x 10 ⁻⁶
Freeze/thaw resistance @ 300 cycles, minimum	C-666	Per Section 509.2.8.4.2, Note 3

^aThe maximum allowable expansion can be 0.4% as long as the locations where enriched concrete is used can tolerate such expansions without exceeding the elastic limit.

533.2.1.3 Rapid-Hardening Cementitious Material

If rapid-hardening cementitious Material is used, it shall comply with all the fresh and hardened properties of the specified concrete, with the additional requirement that the product meet the requirements of ASTM C 928 R3 Standard Specifications for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repair (3,000 psi at three (3) hours, 5,000 psi at one (1) Day, 5,000 psi at seven (7) Days). The Structure may be opened to traffic when it has achieved 75% of the design strength. The in-place concrete strength shall be determined in accordance with Section 510.3.5.2, "In-Place Concrete Strength Measurement."

533.2.1.4 Water

The Contractor shall provide water in accordance with Section 509.2.6, "Water."

533.2.1.5 Epoxy Repair Materials

533.2.1.5.1 Epoxy Repair Materials – Traffic Bearing Surfaces

Epoxy used in bonding skid-resistant Materials to hardened concrete and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements) shall conform to ASTM C881 – Type III.

533.2.1.5.2 Epoxy Repair Materials – Load Bearing Applications

Epoxy used in load bearing applications for bonding hardened concrete to hardened concrete and other Materials and as a binder for epoxy mortars and concretes shall conform to ASTM C881 – Type IV.

533.2.2 Steel Reinforcement

The Contractor shall provide reinforcing steel in accordance with Section 540, “Steel Reinforcement.”

533.2.3 Submittals

The Contractor shall submit manufacturer’s product data sheets at least 14 Days before the start of concrete repair Work that describe the product’s intended use in Structure repair to the Project Manager. The submittal shall include mixing, application, and curing instructions.

533.3 CONSTRUCTION REQUIREMENTS

Care shall be taken during all repair and removal operations to prevent damage to structural components and reinforcing steel being retained.

533.3.1 Establishment of Repair Areas

The Contract will specify approximate repair locations and quantities. The Contractor shall field verify, locate and mark the precise areas of delamination and repair. The Contractor shall obtain Project Manager’s concurrence of established repair areas and establish estimated pay quantities.

533.3.2 Unsound Concrete Removal

The Contractor shall saw cut all boundaries to 3/4 inch depth, and remove concrete with hand-operated devices, chipping hammers, or pavement breakers to a uniform depth within each concrete Structure repair area. The Contractor shall only use removal Equipment that has been approved by the Project Manager.

The following restrictions apply to concrete removal tools:

1. It is Acceptable to use pavement breakers of the 60 lb class for full depth removal and for initial removal of deteriorated concrete located above the top mat of rebar. The Contractor shall not use pavement breakers of the 60 lb class over girders. Maximum 30 lb class shall be used for all else. If, in the opinion of the Project Manager, the use of such devices is detrimental to the integrity of the adjacent concrete Structure, the Contractor shall discontinue the use of pavement breakers. Requests to use 90 lb class pavement breakers may be submitted to the State Bridge Engineer for consideration;

2. The Contractor shall not use chipping hammers heavier than the 15 lb class; and
3. Hydro-demolition may be used upon approval by the Project Manager. A Plan must be submitted by the Contractor for review and Acceptance.

If removal exceeds 50% of the depth of the deck, the Contractor shall perform a full depth repair.

The Contractor shall obtain approval from the Project Manager after completing concrete removal before proceeding with surface preparation.

533.3.3 Concrete Surface Preparation and Cleaning

The Contractor shall prepare the surface in conformance with the manufacturer's application instructions. If the manufacturer does not specify surface preparation, cleaning or bonding, the Contractor shall conform to the following:

1. Mechanically roughen the existing surface using Equipment such as chipping hammers and remove loose debris generated by roughening;
2. Abrasive blast all concrete Structure repair bond surfaces;
3. Ensure the surface substrate is clean, sound, and dry. Remove substances that may prevent a bond between existing and new concrete. If using acid etchers, concrete cleaners, or degreasers to clean the existing surface, remove them completely after cleaning. Before placing repair Materials, clean repair areas with oil-free compressed air or clean pressurized water. The Contractor shall place a four (4) inch piece of duct tape every square yard to test for cleanliness. The Department will not allow concrete placement if more than 25% of the tape surface shows dust coverage;
4. Moisten the substrate with clean water in accordance with Section 509.2.6, "Water" and remove excess water to achieve a saturated surface dry condition; and
5. Use a bonding method per Section 511.3.7.2, "Bonding New Concrete to Existing."

The Contractor shall verify that both the existing substrate and the existing concrete around the perimeter of the concrete Structure repair area is sound in the presence of the Project Manager. If any unsound concrete is detected, the Contractor shall remove that concrete per Section 533.3.2, "Unsound Concrete Removal."

533.3.4 Furnishing, Placing, Curing, and Finishing Concrete Structure Repair Material

The Contractor shall place, finish and cure the repair Material in conformance with the manufacturer's application instructions. If the manufacturer does not specify placement, finishing, and curing of the repair Material; Section 511, "Concrete Structures, and Section 512, "Superstructure Concrete" shall apply as applicable. Epoxy repair Materials shall be used in strict conformance with the Manufacturer's instructions.

With regard to forms, the Contractor shall conform to Section 511, "Concrete Structures" and the following:

1. For full depth replacement, the Contractor shall provide forms to adequately support concrete placed in the full depth repair areas;
2. When stay-in-place forms are present and intact:
 - a. The Project Manager may Accept the utilization of the stay-in-place forms in lieu of temporary forms;
 - b. The Contractor shall be responsible for determining the structural adequacy of

- the stay-in-place forms; and
- c. If the stay-in-place forms are damaged beyond Acceptability for re-use during demolition, the Contractor shall remove the unacceptable stay-in-place form and utilize temporary forms;
 3. Any form bulges and/or failures will be cause for rejection and shall be addressed to the satisfaction of the Project Manager at no additional cost to the Department;
 4. All concrete Structure repair forming shall be constructed so that final finishes match the lines and grades of the surrounding concrete and/or the proposed new lines and grade per the Contract;
 5. The Contractor shall not mix repair Materials within the repair area;
 6. The Contractor shall place mortar or concrete in a continuous operation for each repair area;
 7. For vertical surfaces, the Contractor shall start the Work at the bottom of the patch and continue upwards, and from one edge to the other to prevent the entrapment of air pockets; and
 8. If the repair area abuts or crosses a working joint, the Contractor shall place a temporary strip of waxed wood or pre-molded filler in the joint before placing repair Material. The Contractor shall remove the strips before the concrete sets. The Contractor may also repair areas that occur on both sides of a joint by patching the entire cavity and restoring the joint by saw cutting immediately after the repair Material has set, instead of using a temporary vertical insert strip.

If specified in the Contract, the Contractor shall Finish exposed surfaces of piers, abutments, edges of decks and barrier railings, and other specified locations to a Class 4 finish in accordance with Section 511.3.8.5, "Class 4, Special Surface Finish," and Section 548, "Coating of Concrete" after repairs and curing are complete.

The Contractor shall apply penetrating Water Repellent Treatment in accordance with Section 532, "Penetrating Water Repellent Treatment."

533.3.5 Reinforcing Steel

All standard placement and construction requirements shall apply. The Contractor shall reference Section 540, "Reinforcing Steel," and the following:

1. If the Contractor exposes corroded reinforcing steel during concrete removal, the Contractor shall preserve existing reinforcing steel exposed during concrete removal;
2. The Contractor shall use only hand tools such as hammers and chisels to remove the final concrete particles from reinforcing bars;
3. On decks, if the rebar is exposed, the Contractor shall always chip at least 3/4 inch deep into the adjacent concrete around the entire bar;
4. On anything other than decks, if the bond between exposed bars and adjacent concrete breaks; the Contractor shall chip at least 3/4 inch deep into the adjacent concrete around the entire bar;
5. The Contractor shall supplement or remove and replace reinforcing steel displaying deep pitting or loss of more than 20% of cross-sectional area as directed by the Project Manager. Any rebar that is abandoned in place shall be prepared in the same manner as the adjacent rebar prior to embedment;
6. The Contractor shall strengthen corroded or damaged existing #5 or smaller bars by splicing an equal sized bar at least two (2) ft longer than the corroded or damaged

length. The minimum splice length shall be one (1) ft on each end. The State Bridge Engineer will determine the length of lap for larger reinforcing bars;

7. Any reinforcing steel damaged during concrete removal operations by the Contractor shall be supplemented or removed and replaced by the Contractor at no additional cost to the Department;
8. Mechanical couplers may be used in accordance with Section 540.3.1.4, "Splicing;"
9. The Contractor shall prepare the surface of the reinforcing steel in conformance with the recommendations of the repair Material manufacturer. In the absence of direction from the patch Material supplier, the Contractor shall use abrasive grit blasting or wire brushing to bare metal;
10. The Contractor may leave tight "flash" rust occurring after blast cleaning if Acceptable to the repair Material manufacturer;
11. When epoxy coated bar is present, the Contractor shall repair any damage to the epoxy coating prior to embedment;
12. When galvanic anodes are utilized and epoxy coated rebar is present, repair of epoxy coating is not required;
13. The Contractor shall ensure that minimum concrete cover is maintained. Minimum concrete cover shall match the original design or shall be a minimum of two (2) inches or shall be as noted in the Contract.
14. Reinforcing bars shall be replaced and/or supplemented with the same bar type as is existing unless otherwise noted in the Contract. All reinforcing bar types, including epoxy coated, shall be paid as "Replacement Reinforcing Bars."

533.3.6 Acceptance

The Project Manager will examine repaired areas after the curing period is completed to ensure soundness of the repairs and complete bonding with the existing surface. The Contractor shall remove and replace unacceptable areas at no additional cost to the Department.

533.3.7 Acceptance for 509 Approved Concrete Mixtures

Concrete mixtures that have been approved in accordance with Section 509, "Portland Cement Concrete Mix Designs" shall be tested and Accepted in accordance with Sections 510, "Portland Cement Concrete," 511, "Concrete Structures," and 512, "Superstructure Concrete" as applicable.

533.3.7.1 Acceptance for Prepackaged, Preblended Cementitious Materials

Frequency of testing shall be determined by the Project Manager. If testing is required by the Project Manager, three (3) concrete cylinders for 24 hour compressive strength shall be made by the Department. It is recommended that testing be performed on the first batch and every third batch thereafter. The water to cement ratio of the tested batch(s) shall be consistent with all other batches.

533.4 METHOD OF MEASUREMENT

If the repair depth does not exceed four (4) inches, the Department will measure and pay for the Work by the square yard. For girder Bridges, if the repair depth exceeds four (4) inches, the Department will pay for the deck repair on a prorated rate of 25% of the Bid Item Unit Price for Repair of Concrete Structures per inch deeper than four (4) inches. For concrete slab Bridges, if the repair depth exceeds four (4) inches, the Department will pay for

the deck repair on a prorated rate of ten percent (10%) of the Bid Item Unit Price for Repair of Concrete Structures per inch deeper than four (4) inches. The Department will measure exposed surfaces before the application of the special surface finish.

533.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Repair of Concrete Structures</i>	Square Yard
<i>Replacement Reinforcing Bars</i>	Pound

533.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Sounding;
2. Removal of unsound concrete;
3. Removal and replacement of compromised reinforcing steel to include epoxy anchoring if required;
4. Disposal of old concrete and debris;
5. Surface preparation of concrete and reinforcing bar surfaces;
6. Any additional costs associated with rapid-hardening concrete;
7. Saw cutting operations;
8. Placement and removal of forms;
9. Compliance with manufacturer's instructions;
10. Penetrating water repellent treatment of repaired concrete surfaces;
11. Bonding agent;
12. Curing; and
13. Grinding, rubbing, and final clean up.

SECTION 534: EPOXY INJECTION

534.1 DESCRIPTION

This Work consists of rebonding cracks or delaminations in existing concrete using an epoxy adhesive injection system.

534.2 MATERIAL

534.2.1 General

The Contractor shall use non-shrink epoxy Materials, 100% solid, two-component, moisture-insensitive adhesives in accordance with Table 534.2.1:1, "Epoxy Injection Material Requirements."

**Table 534.2.1:1
Epoxy Injection Material Requirements**

Property	Test	Requirements	
		Type I	Type II
Slant shear strength, minimum ^a	AASHTO T 237	3,000 psi	3,000 psi
Set time @ 77 °F, maximum	AASHTO T 237	18 h	^b
Pot life @ 77 °F, minimum	AASHTO T 237	10 min	60 min
Viscosity @ 77 °F ± 3 °F (poises) ^c	ASTM D 2196	2.5–9.0	90 ± 20
Specific gravity @ 77 °F	—	1.1	1.1
Tensile strength, minimum	ASTM D 638	4,000 psi	4,000 psi
Compressive strength, Minimum	ASTM D 695	6,000 psi	6,000 psi

^aIf bonded to saturated surface dry samples, cure for seven (7) Days at 40 °F and 90 to 100% relative humidity. The Department will use a joint width of 3/16 inch for Type I, and 3/8 inch for Type II for testing purposes.

^bAdhere to the manufacturer's specified set time for construction purposes on these wider cracks.

^cBrookfield #3 spindle, 60 RPM after mixing at slow speed for three (3) min.

The Contractor shall use Type I epoxy Material for cracks less than 1/4 inches wide. The Contractor shall use Type II epoxy Material for cracks 1/4 inch wide or wider. The Contractor shall obtain Department approval of epoxy Materials before use. If the product provides unsatisfactory results, the Department may rescind the approval.

534.2.2 Product Data and Packaging

The Contractor shall label each container with the following:

1. Product name;
2. Component designation, "A" and "B;"
3. Manufacturer's name;
4. Batch number;
5. Ratio of component mixture;
6. Complete instructions for storing, mixing, and using; and
7. Safety requirements.

The Contractor shall package components in separate containers.

534.2.3 Test Reports

The Contractor shall provide Certified Test Results (CTR) for each batch of the epoxy system, verifying that the mixed epoxy is in accordance with Table 534.2.1:1, "Epoxy Injection Material Requirements."

534.2.4 Injection Port Materials

Injection ports are tubes, fittings, pressure plates, or other devices used as entry points for the epoxy adhesive. The Contractor shall use suitable methods to seal each port after injecting epoxy at that port.

534.2.5 Temporary Surface Sealant

The Contractor shall use a temporary surface sealant to retain the injected epoxy adhesive. The Department will also allow pressure plates or other methods for retaining the epoxy adhesive.

534.3 CONSTRUCTION REQUIREMENTS

534.3.1 General

The Contractor shall perform the epoxy injection process in accordance with the manufacturer's recommendations.

The Department will mark cracks and delaminated areas for injection.

The Contractor shall inject epoxy when concrete temperature is between 50 °F and 80 °F. The Contractor shall inject epoxy continuously over the entire crack or area of delamination. The Contractor shall maintain low pumping pressures to prevent lifting the delamination.

534.3.1.1 Epoxy Sampling During Operations

Before starting injection Work, at hourly intervals during continuous injection Work, and when requested by the Project Manager, the Contractor shall take a three (3)-fluid-ounce sample of mixed epoxy from the injection device. If the sample indicates improper proportioning or mixing of the epoxy, the Project Manager will suspend injection Work until the Contractor corrects the problem.

534.3.1.2 Core Sampling

At the Project Manager's discretion, the Contractor shall take core samples from injected cracks and delaminated areas and submit them to the Project Manager to verify penetration and bonding adequacy. The Contractor shall core with a diameter of 1 1/2 inch and to the full crack depth or six (6) inches, whichever is smaller.

If required, the Project Manager will specify core sample locations. The Contractor shall submit at least one (1) core sample for every 50 ft of injected crack or every 50 ft² of injected delamination. The Contractor shall fill core holes with a Department-approved epoxy mortar.

534.3.2 Equipment

The Contractor shall use positive displacing dispensing Equipment that is capable of injecting epoxy at set pressures without pressure build-up.

Where the Contractor uses pressure plates to seal cracks, the Contractor shall use a special pressure fitting on the injection device to prevent leakage.

If the Contractor drills out injection ports, the Contractor shall use drilling Equipment with a vacuum system to remove and not compact drilling dust into cracks or delaminations.

534.3.3 Crack Injection

534.3.3.1 Crack Preparation

The Contractor shall clean surface openings and crack interiors with oil-free compressed air to remove dirt, dust, silt, and other Materials. If the Department determines the result is inadequate, the Contractor shall use another cleaning method such as vacuuming, pressure flushing, routing, or sawing. If using pressure flushing, the Contractor shall blow water out with oil-free compressed air.

534.3.3.2 Injection Ports

Unless the Project Manager approves other methods, the Contractor shall drill holes along the crack to insert the injection ports.

534.3.3.3 Temporary Crack Sealing

The Contractor shall temporarily seal surface openings of cracks between injection ports with material that can retain the epoxy adhesive during pressure injection and until the epoxy hardens.

534.3.3.4 Crack Injection Process

When Material travel is indicated, the nozzle shall be moved to the port that shows epoxy, and the pumped port sealed and this method continued until the crack is completely filled. Where vertical and horizontal cracks intersect, the Contractor shall inject the vertical crack below the intersection first. On wide cracks, where epoxy movement between ports will be rapid, the Contractor may pump two (2) or more ports simultaneously.

534.3.4 Re-bonding Delaminated Areas by Epoxy Injection

534.3.4.1 Injection Ports

The Contractor shall use at least one (1) port for every square yard of delaminated areas.

534.3.4.2 Temporary Sealing of Delaminated Openings

The Contractor shall temporarily seal the surface openings of cracks in the delaminated areas to prevent leakage of epoxy Material.

534.3.4.3 Delamination Injection Process

The Contractor shall begin injection at one port near the perimeter of the delaminated area and continue until there is epoxy at an adjacent port. The Contractor shall then plug the port being pumped and continue the injection at the adjacent port showing epoxy. The

Contractor shall continue this process until the entire delaminated area has been injected. The Contractor may pump two (2) or more ports simultaneously.

534.3.5 Finishing Operations

After curing is complete, the Contractor shall remove excess sealing material from the concrete surface without altering the concrete surface color or texture.

534.3.6 Loading Restrictions

The Contractor shall not allow traffic and other loads on the injected Structures until the epoxy adhesive is solid.

534.4 METHOD OF MEASUREMENT

The Department will verify the measured quantities with the Contractor daily.

534.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Epoxy Injection Type</i>	Gallon

534.5.1 Work Included In Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Surface and crack preparation.
2. Coring, if required.

SECTION 535: CRACK SEALING USING LOW-VISCOSITY, GRAVITY-FED SEALERS

535.1 DESCRIPTION

This Work consists of crack sealing using low-viscosity, gravity-fed sealers.

535.2 MATERIALS

535.2.1 High Molecular Weight Methacrylate

The Contractor shall provide low viscosity, non-fuming HMWM resin selected from the Department's *Approved Products List* and in accordance with Table 535.2.1:1, "HMWM Property Requirements."

**Table 535.2.1:1
HMWM Property Requirements**

Property		
Resin Specifications:	Test	Requirements
Viscosity, centipoises ^a	—	8–25
Specific gravity	—	1.00–1.07
Flash point, °F, minimum	Pinsky-Martens CC	180
Tensile elongation, %, minimum	ASTM D 638	5
Performance Properties of Resin:		
Cure speed:	—	—
Surface cure, hours, maximum @ 73 °F		8
@ application temperature	—	24
Gel time, minutes, @ application temperature, 50 ml sample	—	20–90

^aBrookfield Model LVT Viscometer, Spindle 1 at 60 rpm.

535.2.2 Low Viscosity, Low Surface Tension Polymer

The Contractor shall use low-viscosity, low surface tension polymer selected from the Department's *Approved Products List* and in accordance with Table 535.2.2:1, "Physical Properties of Low-Viscosity, Low Surface Tension Crack Sealer."

**Table 535.2.2:1
Physical Properties of Low-Viscosity, Low Surface Tension Crack Sealer**

Property	Value
Compressive strength (psi), ASTM D 695 minimum @ seven (7) Days	5,500
Tensile strength (psi), ASTM D 638, minimum @ seven (7) Days	3,100
Tensile elongation, %, ASTM D 638, minimum @ seven (7) Days	30
Water absorption, % by weight, ASTM D 570, maximum @ 24 h	0.10
Shore D hardness, 77 °F, minimum	65
Gel time, minutes - 7.0 ounces	48–52
Adhesion to concrete	100% failure in concrete
Surface tension, maximum	32 Dynes/cm

**Table 535.2.2:1
Physical Properties of Low-Viscosity, Low Surface Tension Crack Sealer**

Property	Value
Percent solids	100

535.2.3 Fine Aggregate

The Contractor shall provide fine aggregate for spreading over treated areas that is free from dirt, clay, asphalt, and other Deleterious Materials, and has moisture content of less than 0.2% when applied. Unless otherwise approved by the State Materials Bureau, the Contractor shall provide sand in accordance with Table 535.2.3:1, "Fine Aggregate Gradation Requirements."

**Table 535.2.3:1
Fine Aggregate Gradation Requirements**

Sieve size	% passing	
	Minimum	Maximum
No. 8	95	100
No. 16	30	70
No. 30	0	3
No. 100	0	1

535.3 CONSTRUCTION REQUIREMENTS

535.3.1 General

The Contractor shall seal individual cracks to refusal. Where closely spaced map cracking has occurred on concrete Bridge decks, the Contractor shall seal by flooding the entire surface to refusal. The Project Manager will direct which method to use.

535.3.1.1 Planning and Demonstration

At least 21 Days before applying the sealer, the Contractor shall submit a written crack-sealing plan to the Project Manager that includes the following:

1. Material descriptions;
2. Deck preparation and application methods;
3. Safety considerations for blasting and sealing personnel; and
4. Plans to protect other persons, vehicles, and property from injury or damage.

535.3.1.2 Sequence of Operations

The Contractor shall seal cracks on new concrete Bridge decks or approach slabs after 28 Days of curing or per the manufacturer's recommendations.

535.3.2 Surface Preparation

The manufacturer's application requirements shall govern. If the manufacturer does not provide guidance on the following items, the following shall apply:

1. The Contractor shall clean concrete surfaces from three (3) inches to five (5) inches on either side of individual cracks;
2. The Contractor shall remove asphalt Material, oil, dirt, rubber, curing compounds,

- paint, and other Deleterious Materials by grinding, sandblasting, and/or shot blasting;
3. The Contractor shall air blast, with oil free compressed air, or vacuum all loose Material from visible cracks;
 4. The concrete shall be dry at the time of overlay application. The criteria for “dry” shall be established by:
 - a. ASTM D 4263: for every 500 square feet, an 18 inch x 18 inch plastic sheet shall be taped to the deck with two (2) inch duct tape. The test area shall be protected from direct sunlight, direct heat, and damage to the plastic. After 16 hours, the concrete shall be considered dry when no moisture appears on the bottom of the plastic; and
 - b. It is also Acceptable to use a moisture meter in conformance with ASTM F2659;
 - i. Unless otherwise directed by the manufacturer, the reading shall be four percent (4%) or less;
 - ii. The meter shall be an electrical impedance moisture meter specifically developed and calibrated for the non-destructive measurement of the comparative moisture condition in concrete floor slabs; and
 - iii. The moisture meter shall be used and calibrated in accordance with the manufacturer’s written recommendations. The moisture meter manufacturer’s recommendations and the calibration data shall be provided to the Project Manager for Acceptance prior to use on the Project; and
 5. The Contractor shall prepare the concrete surface per the manufacturer’s recommendations. In the absence of the manufacturer’s recommendations, the Contractor shall prepare the concrete surface to produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation CSP 5-8, or ASTM E 965 pavement macrotexture depth from 0.04 inch to 0.10 inch. The Contractor shall provide ICRI concrete surface profile chips to the Project Manager for inspection of prepared surface. ICRI concrete surface profile chips will become the property of the Department.

535.3.3 Storage of Sealer

The Contractor shall store the sealer or its components separately and within the manufacturer recommended temperature ranges.

535.3.4 Application of Sealer

Surface temperature shall comply with the minimum manufacturer’s recommendations. The Contractor shall follow the manufacturer’s mixing and application recommendations. The Contractor shall apply one (1) gal per 200 ft for crack sealing and one (1) gal per 100 ft² for surface sealing. The Department may require two (2) or more applications of sealer for cracks ¹/₃₂ inch or larger. The Department may require application of a temporary surface sealer to wider, full depth deck cracks on the deck underside.

Prior to use on the Project, the Contractor shall ensure that the curing period recommended by the manufacturer confirms proper curing of the Material.

535.3.4.1 Excess Sealer

The Contractor shall sweep away sealer that does not fill cracks, is not absorbed by the concrete surface, and fills or partially fills the grooves of a tined or grooved surface.

535.3.5 Application

The Contractor shall apply dry fine aggregate with coverage of eight (8) lb per square yard. The Contractor shall place sand before the sealer starts to gel. The Contractor shall remove excess sand after the curing period.

535.3.6 Limitation of Operations

The Contractor shall prevent the sealer from leaking through cracks onto persons, traffic, and property. If deck preparation procedures or the sealer deface the appearance of Bridge components other than the crack sealed areas, the Contractor shall repair those components at no additional cost to the Department.

535.4 METHOD OF MEASUREMENT

Crack sealing will be measured by the linear foot. Concrete surface treatment will be measured by the square yard.

535.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Crack Sealing</i>	Linear Foot
<i>Concrete Surface Treatment</i>	Square Yard

535.5.1 Work Included In Payment

The Department will consider as included in the payment for the pay item(s) listed in this section all Work as described in this Section:

1. Surface preparation; and
2. ICRI Concrete Surface Profile Chips.

SECTION 536: POLYMER CONCRETE BRIDGE DECK OVERLAY

536.1 DESCRIPTION

This Work consists of providing and applying a polymer concrete Bridge deck overlay.

536.2 MATERIALS

The Contractor shall use epoxy or epoxy urethane from the Department's Approved Products List. The Contractor shall notify the Project Manager of the selection at least 14 Days before start of Work. The Contractor shall provide Materials in accordance with Table 536.2.1:1, "Epoxy Physical Requirements" and Table 536.2.1:2, "Epoxy Urethane Physical Requirements."

536.2.1 Epoxy

The Contractor shall provide a two (2) part epoxy, or epoxy urethane resin base, composed of a 100% solid, thermosetting, moisture-insensitive, flexible, high-elongation compound in accordance with Table 536.2.1:1, "Epoxy Physical Requirements," or Table 536.2.1:2, "Epoxy Urethane Physical Requirements."

**Table 536.2.1:1
Epoxy Physical Requirements**

Property	Test method	Minimum	Maximum	Remarks
Viscosity	ASTM D 2393 Brookfield RVT, Spindle #3 @ 20 rpm or ASTM C 881	Seven (7) poises	25 poises	—
Gel time	ASTM C 881, Paragraph 11.2 modified	15 min	45 min	—
Compressive strength @ three (3) h	ASTM C 579 modified (with plastic inserts)	1,000 psi	—	Mixed with aggregate
Compressive strength @ 24 h	ASTM C 579 modified (with plastic inserts)	5,000 psi	—	Mixed with aggregate
Tensile strength (neat) @ seven (7) Days	ASTM D 638	2,200 psi	5,000 psi	—
Elongation (neat) @ seven (7) Days	ASTM D 638	30%	80%	—
Adhesive strength @ 24 h	ACI 503R, Appendix A, VTM 92	250 psi	—	Mixed with aggregate with 100% failure in concrete
Permeability to chloride ion @ 28 Days	AASHTO T 277	—	100 coulombs	—
Absorption (neat) @ 24 h	ASTM D 570	—	One percent (1%)	—

**Table 536.2.1:1
Epoxy Physical Requirements**

Property	Test method	Minimum	Maximum	Remarks
Thermal compatibility	ASTM C 884	No delamination of overlay		Mixed with aggregate
Infrared spectrum	AASHTO T 237, Paragraphs 5 and 6	To be established for each component		—

**Table 536.2.1:2
Epoxy Urethane Physical Requirements**

Property	Test method	Minimum	Maximum	Remarks
Viscosity	ASTM D 2393 Brookfield RVT, Spindle #3 @ 20 rpm	20 poises	70 poises	—
Gel time	ASTM C 881, Paragraph 11.2 modified	15 min	45 min	—
Compressive strength @ three (3) h	ASTM C 579 modified (with plastic inserts)	1,000 psi	—	Mixed with aggregate
Compressive strength @ 24 h	ASTM C 579 modified (with plastic inserts)	5,000 psi	—	Mixed with aggregate
Tensile strength (neat) @ seven (7) Days	ASTM D 638	2,200 psi	5,000 psi	—
Elongation (neat) @ seven (7) Days	ASTM D 638	30%	100%	—
Adhesive strength @ 24 h	ACI 503R, Appendix A, VTM 92	250 psi	—	Mixed with aggregate with 100% failure in concrete
Permeability to chloride ion @ 28 Days	AASHTO T 277	—	100 coulombs	—
Shore D hardness	ASTM D 2240	65	75	—
Flexural creep, total movement in seven (7) Days	California Test Method 419	0.0065 in	—	—
Flexural yield strength	ASTM D 790	5,000 psi	—	—
Absorption (neat) @ 24 h	ASTM D 570	—	One percent (1%)	—
Thermal compatibility	ASTM C 884	No delamination of overlay		Mixed with aggregate
Infrared spectrum	AASHTO T 237, Paragraphs 5 and 6	To be established for each component		—

536.2.2 Submittals

The Contractor shall submit the manufacturer's recommendations for the proposed Material to the Project Manager 14 Days before use. The Contractor shall provide a manufacturer certification verifying the Materials are in accordance with this Specification. The Contractor shall include a Fourier Transform Infrared Spectrophotometry spectrum in transmittance mode and a bulk sample of each component tested in the manufacturer's certification. The Department will maintain confidentiality of the data.

536.2.3 Testing

The Project Manager will Accept the Materials based on the certified Laboratory report.

536.2.4 Aggregate

The Contractor shall provide angular graded, stone aggregate free of dirt, clay, and Deleterious Material in accordance with Table 536.2.4:1, "Required Aggregate Properties," and Table 536.2.4:2, "Required Aggregate Gradation."

**Table 536.2.4:1
Required Aggregate Properties**

Property	Test method	Minimum	Maximum	Remarks
Soundness loss, 5 cycles in magnesium sulfate	AASHTO T 104	—	Eight percent (8%)	—
Micro-Deval	AASHTO T 327	—	Ten percent (10%)	Aggregate must meet the gradation shown in Table 536.2.4:2, "Required Aggregate Gradation"
Moh's hardness	—	7	—	—
Moisture content	AASHTO T 255	—	0.2%	—

**Table 536.2.4:2
Required Aggregate Gradation**

Sieve size	% passing	
	Minimum	Maximum
No. 4	100	—
No. 8	15	25
No. 16	0	5
No. 30	0	1
No. 200	0	0.2

536.3 CONSTRUCTION REQUIREMENTS

536.3.1 Equipment

The Contractor shall only use vehicles and Equipment that are clean and do not drip engine fluids, or install drip pans to protect the clean deck and overlay.

536.3.1.1 Concrete Surfacing and Cleaning Equipment

The Contractor shall use scabblers, grinding/milling machine, sand blasting, and/or shot blasting.

The use of air compressors and/or vacuum trucks is permitted. The Contractor shall use an air compressor that produces oil-free and moisture-free compressed air to remove dust and loose Material from the application surface before applying the prime coat.

536.3.1.2 Placing and Finishing Equipment

536.3.1.2.1 Mechanical Application Equipment

The Contractor shall apply Materials using mechanical metering, mixing and distribution machinery as recommended by the manufacturer of the overlay system. The Contractor shall use an epoxy or epoxy urethane distribution system that completely mixes the epoxy or epoxy urethane resin with hardening agent, and provides a uniform distribution of the Materials at the required application rate. The use of hand held machine mixing Equipment or hand mixing Equipment is prohibited.

The Contractor shall use a self-propelled aggregate spreader that uniformly applies the dry aggregate at the manufacturer's recommended application rate.

The Contractor shall use an air compressor that produces oil-free and moisture-free compressed air to remove dust and loose Material from the application surface before applying epoxy or epoxy urethane.

536.3.1.2.2 Hand Application Equipment

The Contractor shall use notched squeegees and brooms that spread the epoxy or epoxy urethane Material in accordance with the manufacturer's requirements. The Contractor shall periodically inspect squeegees during application for wear of the notch depth, replace any defective squeegees.

The Contractor shall use hand tools, as necessary and as approved by the Project Manager, for placing aggregate in small areas that are unsuitable for mechanical spreading. The dry aggregate shall be placed at the minimum rate of ten (10) lb per sy or the Manufacturer's recommended application rate, whichever is greater.

536.3.1.2.3 Vacuum Trucks

The Contractor shall use vacuum trucks that are clean and do not drip engine fluids, or install drip pans to protect the clean deck and overlay.

536.3.1.2.4 Power Brooms

The Contractor shall use power brooms that are clean and do not drip engine fluids, or install drip pans to protect the clean deck and overlay.

536.3.2 Preapplication

536.3.2.1 Deck Preparation

The Contractor shall complete deck repairs for patches, delamination, and crack filling

before applying the overlay per Section 533, "Concrete Structure Repair" and Section 534, "Epoxy Injection" as specified in the Contract.

The Contractor shall close and protect deck drains and areas of curb or railing above the proposed surface to ensure epoxy or epoxy urethane and aggregate does not pass through the drains.

536.3.2.2 Surface Preparation

The Contractor shall prepare the concrete surface per the manufacturer's recommendations. In the absence of the manufacturer's recommendations, the Contractor shall prepare the concrete surface to produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation CSP 5-8, or ASTM E 965 pavement macrotexture depth from 0.04 inch to 0.10 inch. The Contractor shall provide ICRI concrete surface profile chips to the Project Manager for inspection of prepared surface. ICRI concrete surface profile chips will become the property of the Department.

536.3.2.3 Cleaning

Before placing the overlay, the Contractor shall clean the deck surface to remove Materials that may interfere with bonding or curing.

The Department will consider cleaning Acceptable when the color of the concrete and mortar changes and coarse aggregate particles are exposed. Cleaning shall open the pores of sound mortar. The Department will consider pavement markings clean when exposed aggregate shows through the markings. The Contractor shall use a vacuum cleaner or air compressor to remove dust and other loose Material. The Contractor shall not use brooms.

The Contractor shall obtain Project Manager's approval of Bridge deck cleaning and preparation before placing the first course.

536.3.3 Safety Provisions

The Contractor shall use personnel certified in the safe handling of Materials in accordance with the manufacturer's requirements. The Contractor shall submit written documentation of Material handlers' training to the Project Manager before applying the overlay.

536.3.4 Storage of Materials

The Contractor shall store Materials in accordance with the manufacturer's recommendations.

536.3.5 Usage Limitations

The manufacturer's application requirements shall govern. If the manufacturer does not provide guidance on the following items, the following shall apply:

1. PCC shall not be less than 28 Days of age at the time of overlay;
2. The concrete shall be dry at the time of overlay application. The criteria for "dry" shall be established by:
 - a. ASTM D 4263: for every 500 square feet, an 18 inch x 18 inch plastic sheet shall be taped to the deck with two (2) inch duct tape. The test area shall be protected from direct sunlight, direct heat, and damage to the plastic. After 16

hours, the concrete shall be considered dry when no moisture appears on the bottom of the plastic; and

- b. It is also Acceptable to use a moisture meter in conformance with ASTM F2659;
 - i. Unless otherwise directed by the manufacturer, the reading shall be four percent (4%) or less;
 - ii. The meter shall be an electrical impedance moisture meter specifically developed and calibrated for the non-destructive measurement of the comparative moisture condition in concrete floor slabs; and
 - iii. The moisture meter shall be used and calibrated in accordance with the manufacturer's written recommendations. The moisture meter manufacturer's recommendations and the calibration data shall be provided to the Project Manager for Acceptance prior to use on the project; and
3. The air and deck temperature shall be a minimum of 40 °F at the time of overlay application, and for eight (8) hours after overlay application. Do not use artificial methods to raise the deck temperature.

For new Bridge decks with unventilated stay-in-place forms, in addition to the manufacturer's application requirements, the Contractor shall not install the overlay on PCC that is less than 56 Days of age.

536.3.6 Application

The Contractor shall follow the manufacturer's application instructions.

Components A and B shall be applied within the temperature range recommended by the manufacturer. Broadcasting on concrete shall be performed in accordance with the manufacturer's directions and the method approved by the Project Manager.

The Contractor shall apply the overlay as two (2) separate applications with a total coverage of at least 7.5 gal per 100 ft².

The Contractor shall apply the first application of polymer at a rate of at least 2.5 gal per 100 ft². The Contractor shall cover with a minimum of ten (10) pounds of aggregate per square yard, or enough to completely cover the epoxy or epoxy urethane.

The Contractor shall apply the second application of polymer at a rate of at least five (5.0) gal per 100 ft². The Contractor shall cover with at least 14 pounds of aggregate per square yard, or enough to completely cover the epoxy or epoxy urethane.

The Contractor shall remove and replace first applications that do not receive enough aggregate before the polymer gels, at no additional cost to the Department. The Department will allow second applications not covered with enough aggregate to remain in place, but the Contractor must apply additional applications before opening to traffic, at no additional cost to the Department.

536.3.7 Curing

The Contractor shall not allow vehicular traffic or Equipment on the overlay during the curing period.

The Contractor shall cure each application of overlay (polymer and aggregate) free from

vehicular traffic and until vacuuming or broom does not tear or damage the surface, as determined and approved by the Project Manager.

After the first application cures, the Contractor shall remove loose aggregate with a vacuum or broom, prior to the second application.

536.3.8 Expansion Joints

The Contractor shall place expansion joints with bond breakers in Bridge deck expansion joints. The Contractor shall apply polymer over the expansion joints. Within 12 h after application and before opening to traffic, the Contractor shall remove the polymer over the expansion joints using the following procedure:

1. Remove the bond breakers;
2. Score the polymer before gelling; or
3. Saw cut after the cure.

536.3.9 Corrective Work

The Contractor shall correct surface variations that exceed $\pm 1/4$ inch per three (3) ft, unless otherwise directed by the Project Manager.

The Contractor shall repair the damaged overlay areas by saw cutting in rectangular sections to the top of the concrete deck surface and replacing the Material at no additional cost to the Department.

536.4 METHOD OF MEASUREMENT

Epoxy (polymer or urethane polymer) concrete Bridge deck overlay will be measured by the square yard. Deck repair shall be paid under Section 533, "Concrete Structure Repair" unless noted in the contract as Incidental to Section 536, "Polymer Concrete Bridge Deck Overlay." If an existing overlay must be removed prior to the application of the new overlay, removal shall be paid under Section 601, "Removal of Structures and Obstructions" unless noted in the Contract as Incidental to Section 536, "Polymer Concrete Bridge Deck Overlay."

536.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Epoxy Polymer Concrete Bridge Deck Overlay</i>	Square Yard
<i>Epoxy Urethane Polymer Concrete Bridge Deck Overlay</i>	Square Yard

536.5.1 Work Included in Payment

The following Work and item(s) will be considered as included in the payment and will not be measured or paid for separately:

1. ICRI Concrete surface profile chips; and
2. Surface preparation.

SECTION 537: POLYESTER/EPOXY CONCRETE OVERLAY

537.1 DESCRIPTION

This Work consists of providing and applying polyester/epoxy concrete overlay for Bridge deck, approach slab, transition slab, and PCCP repairs and/or grade corrections.

537.2 MATERIALS

The Contractor shall use prime coat and polyester or epoxy resin binder. The Contractor shall notify the Project Manager of the selection at least 14 Days before start of Work. The Contractor shall provide Materials in accordance with Table 537.2.1:1, "Prime Coat Physical Requirements" and Table 537.2.2:1, "Resin Binder Physical Requirements."

537.2.1 Prime Coat

For polyester concrete (PPC) the prime coat used with the polymer concrete shall be a wax free, high molecular weight methacrylate resin conforming to the requirements in Table 537.2.1:1, "Prime Coat Physical Requirements." For epoxy polymer concrete (EPC), the prepared surface shall receive a primer layer of two (2)-component, low modulus epoxy resin conforming to the requirements of Table 537.2.1:1, "Prime Coat Physical Requirements," or as recommended by the manufacturer.

**Table 537.2.1:1
Prime Coat Physical Requirements**

Property	Test method	Minimum	Maximum	Remarks
Viscosity (PPC)	ASTM D 2196	0.25	1.75 poise	—
Viscosity (EPC)	ASTM D 2393 or ASTM C 881		1.5 poise	
Specific Gravity	ASTM D1475	0.90 min	—	—
Flash Point*	ASTM D3278	180 F	—	—

* Polyester polymer concrete only

The promoter/initiator system for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, the metal drier shall not be mixed with or allowed to contact the peroxide directly. The Contractor shall not store the containers in a manner that will allow leakage or spillage from one (1) Material to contact the container or Material of the other.

537.2.2 Polyester/Epoxy Resin Binder

Polymer concrete shall consist of polyester or epoxy resin binder. The polyester polymer concrete, the resin shall be an unsaturated isophthalic polyester-styrene co-polymer and shall conform to the requirements in Table 537.2.2:1, "Resin Binder Physical Requirements." For epoxy polymer concrete, the resin shall be a two (2)-component, low modulus epoxy polymer conforming to the requirements of Table 537.2.2:1, "Resin Binder Physical Requirements."

**Table 537.2.2:1
Resin Binder Physical Requirements**

Property	Test method	Minimum	Maximum	Remarks
Viscosity	ASTM D 2196	0.75 poise	2.0 poise	Test before addition of initiator
Specific Gravity	ASTM D 1475	1.05	1.10	Test before addition of initiator
Tensile strength (neat) @ 7 Days	ASTM D 638	2,200 psi	5,000 psi	—
Elongation (neat) @ 7 Days	ASTM D 638	35%	80%	—
Adhesive strength @ 24 h	ACI 503R, Appendix A, VTM 92	250 psi	—	Mixed with aggregate with 100% failure in concrete
Absorption (neat) @ 24 h	ASTM D 570	—	One percent (1%)	—
Styrene Content	ASTM D 2369	40%	50%	% mass as volatiles before addition of initiator
Infrared spectrum	AASHTO T 237, Paragraphs 5 and 6	To be established for each component		—

The silane coupler shall be an organosilane ester, gammamethacryloxy-propyltrimethoxysilane. The promoter shall be compatible with suitable methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators.

537.2.3 Aggregate

Aggregate for polyester/epoxy concrete shall conform to the requirements of Section 509.2.4, "Aggregate," except the gradation shall meet the following:

**Table 537.2.3:1
Polymer Concrete Aggregate Gradation**

COMBINED AGGREGATE		
Sieve Size	Percentage Passing	
	3/8 inch Max.	No. 4 Max.
1/2 inch	100	100
3/8 inch	83 - 100	100

**Table 537.2.3:1
Polymer Concrete Aggregate Gradation
COMBINED AGGREGATE**

Sieve Size	Percentage Passing	
	3/8 inch Max.	No. 4 Max.
No. 4	65 - 82	62 - 85
No. 8	45 - 64	45 - 67
No. 16	27 - 48	29 - 50
No. 30	12 - 30	16 - 36
No. 50	6 - 17	5 - 20
No. 100	0 - 7	0 - 7
No. 200	0 - 3	0 - 3

Aggregate retained on the #8 sieve shall have a maximum of 45 percent crushed particles when tested in accordance with AASHTO Test Method T 27. Fine aggregate shall consist of natural sand only.

Aggregate absorption shall not exceed one percent (1%) as determined by AASHTO Test Methods T 84 and T 85.

At the time of mixing with the resin, the moisture content of the aggregate, as determined by AASHTO Test Method T 255, shall not exceed one half of the aggregate absorption.

537.2.4 Wear Surface Sand

The sand shall be commercial quality blast sand, conforming to the absorption capacity and moisture content requirements of polyester/epoxy concrete aggregate of this Specification. The Contractor shall provide sand such that 95% shall pass the No. 8 sieve and 95% shall be retained on the No. 20 sieve.

537.2.5 Submittals

The Contractor shall submit the manufacturer's recommendations for the proposed Material to the Project Manager 14 Days before use. The Contractor shall provide a manufacturer certification verifying the Materials are in accordance with this Specification.

The Contractor shall submit proposed locations of the longitudinal and transverse joints for approval. The Contractor shall not locate the longitudinal joints in wheel lines.

537.3 CONSTRUCTION REQUIREMENTS

537.3.1 Equipment

537.3.1.1 Concrete Surfacing and Cleaning Equipment

The Contractor shall use scabblers, grinding/milling machine, sand blasting, and/or shot blasting.

The use of air compressors and/or vacuum trucks is permitted. The Contractor shall use an air compressor that produces oil-free and moisture-free compressed air to remove dust and

loose Material from the application surface before applying the prime coat. The Contractor shall use vacuum trucks that are clean and do not drip engine fluids, or install drip pans to protect the clean concrete surfaces and overlay.

537.3.1.2 Placing and Finishing Equipment

A continuous mixer, employing an auger screw/chute device, will be approved for use by the Project Manager contingent on a demonstration that the device can consistently produce a satisfactory product. The continuous mixer shall 1) be equipped with a metering device that automatically measures and records the aggregate volumes and the corresponding resin volumes, and 2) have a readout gage, visible to the Project Manager at all times, that displays the volumes being recorded. The volumes shall be recorded at no greater than five (5) minute intervals along with the time and date of each recording. A printout of the recording shall be furnished to the Project Manager at the end of each Work shift. The Contractor shall furnish slip-form finishing Equipment with an automatic grade control device to strike off the overlay to the established grade and cross section, unless otherwise pre-approved by the State Bridge Engineer. The Contractor shall fit finishing Equipment with vibrators or other means of consolidating the overlay Material. Finishing machines shall be self-propelled and capable of forward and reverse movement under positive control. Finishing machines shall be operated normal to the longitudinal Bridge or Roadway centerline.

Equipment shall be fitted with suitable traps, filters, drip pans, or other devices as necessary to prevent oil or other Deleterious Material from being deposited onto the existing concrete surfaces.

537.3.2 Pre-Application

537.3.2.1 Material Suppliers

The polyester/epoxy concrete overlay system Supplier shall make available a technical representative for a minimum of three (3) Days to make recommendations to facilitate overlay installation. This shall include, but not be limited to, trial batch preparation, trial overlay placement, surface preparation, overlay application and overlay cure.

The system Supplier shall also provide health and safety training for personnel who are to handle the Materials.

537.3.2.2 Trial Batches and Trial Overlay

The Contractor shall mix one (1) or more trial batches of polyester/epoxy concrete for various percentages of resin binder according to manufacturer's recommendations. The approximate percentage of polyester/epoxy resin binder to use will be determined from the trial batches.

The Materials, methods, and Equipment used in the trial batches shall be the same as those intended for use in the trial overlay. If at any time different Materials, methods, or Equipment are to be used, new trial batches will be required.

The Contractor shall place one (1) or more trial overlays on a previously constructed concrete base to demonstrate the effectiveness of the proposed mixing, placing, and finishing Equipment. Each trial overlay shall be 12 ft wide, at least six (6) ft long, and the same thickness as the overlay to be constructed. The trial overlay area shall be within the Project limits and at a location approved by the Project Manager.

The Contractor shall remove and dispose of all Materials used in the trial batches, including the concrete base.

537.3.2.3 Deck Preparation

The Contractor shall complete concrete repairs for patches, delamination, and crack filling per Section 533, "Concrete Structure Repair" as specified in the Contract, before applying the overlay. The Contractor shall use polyester/epoxy concrete as a patching Material. The Contractor shall apply patch Material at least one (1) hour before placing the overlay or place the patch Material and overlay monolithically.

The Contractor shall close and protect Bridge deck drains and areas of curb or railing above the proposed surface to ensure that the prime coat, polyester/epoxy concrete and aggregate do not contaminate these areas.

The Contractor shall adequately isolate expansion joints and weakened plane joints before overlaying or saw them by approved methods within four (4) hours after overlay placement.

537.3.2.4 Surface Preparation

The Contractor shall prepare the concrete surface per the manufacturer's recommendations. In the absence of the manufacturer's recommendations, the Contractor shall prepare the concrete surface to produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation CSP 5-8, or ASTM E 965 pavement macrotexture depth from 0.04 inch to 0.10 inch. The Contractor shall provide ICRI concrete surface profile chips to the Project Manager for inspection of prepared surface. ICRI concrete surface profile chips will become the property of the Department.

537.3.2.5 Cleaning

Before placing the overlay, the Contractor shall clean the concrete surface to remove Materials that may interfere with bonding or curing. The Contractor may use a vacuum truck or air compressor to remove dust and other loose Material. The Contractor shall not use brooms or power brooms.

The Contractor shall obtain Project Manager's inspection of concrete cleaning and preparation before placing the prime coat.

537.3.3 Safety Provisions

The Contractor shall use personnel certified in the safe application and handling of Materials in accordance with the manufacturer's requirements. The Contractor shall provide a soap and water wash station for the workers at the job site. The Contractor shall submit written documentation of Material applicators' training to the Project Manager before applying the overlay.

537.3.4 Storage of Materials

The Contractor shall store Materials in accordance with the manufacturer's recommendations.

537.3.5 Usage Limitations

The manufacturer's application requirements shall govern. If the manufacturer does not provide guidance on the following items, the following shall apply:

1. PCC shall not be less than 28 Days of age at the time of overlay;
2. The concrete shall be dry at the time of overlay application. The criteria for "dry" shall be established by:
 - a. ASTM D 4263: for every 500 square feet, an 18 inch x 18 inch plastic sheet shall be taped to the deck with two (2) inch duct tape. The test area shall be protected from direct sunlight, direct heat, and damage to the plastic. After 16 hours, the concrete shall be considered dry when no moisture appears on the bottom of the plastic;
 - b. It is also Acceptable to use a moisture meter in conformance with ASTM F2659;
 - i. Unless otherwise directed by the manufacturer, the reading shall be four percent (4%) or less;
 - ii. The meter shall be an electrical impedance moisture meter specifically developed and calibrated for the non-destructive measurement of the comparative moisture condition in concrete floor slabs.
 - iii. The moisture meter shall be used and calibrated in accordance with the manufacturer's written recommendations. The moisture meter manufacturer's recommendations and the calibration data shall be provided to the Project Manager for Acceptance prior to use on the Project; and
3. The air and deck temperature shall be a minimum of 40 °F at the time of overlay application, and for eight (8) hours after overlay application. Do not use artificial methods to raise the deck temperature.

For new Bridge decks with unventilated stay-in-place forms, in addition to the manufacturer's application requirements, the Contractor shall not install the overlay on PCC that is less than 56 Days of age.

537.3.6 Application

The Contractor shall follow the manufacturer's application instructions.

The prime coat shall be uniformly applied to completely cover the surface to receive the polyester/epoxy concrete. The Contractor shall apply the prime coat at an approximate rate of 0.09 to 0.11 gal/yd² or per the manufacturer's recommendations prior to placement of polyester/epoxy concrete. The Contractor shall flood concrete surfaces with the prime coat, allowing penetration into the concrete and filling of all cracks. The Contractor shall redistribute the applied prime coat in cracks by squeegees or brooms. The quantity of initiated, promoted resin shall be no more than what is needed to apply a prime coat. A noticeable increase in viscosity prior to placement will be cause for rejection. If the primed surface becomes contaminated, or if there is a failure of the Material, the Contractor shall clean the contaminated or failed area by abrasive blasting and re-prime.

Immediately after the prime coat has been applied, the polyester/epoxy concrete overlay shall be placed, in accordance with manufacturer's guidelines.

The Contractor shall mix polyester/epoxy concrete in mechanically operated mixers. The Contractor shall use a sufficient amount of initiator in the polyester/epoxy concrete to produce set times between 30 and 120 minutes after placement. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the resin Supplier.

The Contractor shall place and finish polyester/epoxy concrete before gelling or within 15 minutes following addition of the initiator, whichever occurs first. The Contractor shall discard polyester/epoxy concrete not placed within this time.

The Contractor shall construct longitudinal construction joints parallel to the Roadway alignment only at the submitted and approved locations. The Contractor shall construct vertical joints perpendicular to the deck surface.

The smoothness of the polyester/epoxy concrete surface will be tested with a straightedge. The surface shall not vary by more than 0.02 feet from the lower edge of a ten (10) foot +/- 0.2 feet long straightedge placed in any direction. Any surface that fails to conform to the above tolerance shall be ground to meet this requirement.

The Contractor shall apply abrasive sand finish to polyester/epoxy concrete surfaces. The Contractor shall apply the sand finish by mechanical means immediately after overlay strike-off. The Contractor shall broadcast sand uniformly onto the surface before gelling occurs at the rate from the manufacturer's application instructions.

For polyester concrete Materials, it is Acceptable to tine or groove. For epoxy concrete Materials, grooving is required, tining is not allowed.

The Contractor shall groove in accordance with Section 512.3.10.3, "Grooving of Hardened Concrete."

For tining of polyester concrete Materials, after application of the sand finish and before gelling occurs, the Contractor shall texture the overlay by tining with a steel-tined rake with tines 1/8 inch wide and spaced from 3/4 inch to 1-1/2 inches apart. The Contractor shall tine to a depth of 1/8 inch to 3/16 inch. The surface texture of the overlay shall be uniform and shall have a coefficient of friction not less than 0.35. If the coefficient of friction is less than 0.35, the Contractor shall additionally groove in accordance with Section 512.3.10.3, "Grooving of Hardened Concrete."

537.3.7 Curing

The Contractor shall protect the finished overlay from moisture, Equipment, and public traffic until the overlay achieves an average Schmidt hammer reading of 24. The Schmidt hammer test shall consist of the average of ten (10) readings (strikes), all taken in an area approximately 18 inches in diameter. The Contractor shall perform one (1) such test per 500 sq ft of overlay. Traffic may be allowed on the overlay when the reading of 24 is achieved.

The Contractor shall not contaminate concrete surfaces during clean-up of tools and Equipment. The Contractor shall not dump or spill polyester/epoxy concrete Materials or cleaning solvents in areas that will cause environmental or fire hazards.

537.3.8 Reserved

537.3.9 Testing

The Contractor shall provide the necessary Equipment and supplies for conducting adhesion tests on the completed overlay. The Contractor shall perform adhesion tests according to ACI 503R - Appendix A of the ACI Manual of Concrete Practice. Adhesion tests shall obtain a 250 psi minimum pulloff or cohesive failure within existing concrete. The Contractor shall perform tests at a frequency of one (1) test per every 1600 sq ft of deck

surface in a random location. The Contractor shall prime and patch test holes with polyester/epoxy concrete immediately after testing.

537.3.10 Corrective Work

The Contractor shall correct surface variations that exceed ± 0.02 ft per ten (10) ft, unless otherwise directed by the Project Manager.

The Contractor shall repair damaged overlay areas by saw cutting in rectangular sections to the top of the concrete surface and replacing the Material at no additional cost to the Department.

In the event that the testing performed under 537.3.9, "Testing" does not meet minimum pulloff; the Material shall be removed and replaced in the areas in which low adhesion is determined from additional testing. Any additional testing required shall be Incidental to the Work.

537.4 METHOD OF MEASUREMENT

Polyester/epoxy concrete will be measured by the cubic yard. The volume to be paid for will be determined from calculations based on the quantity of resin binder used, the percent by weight of resin binder in the polyester/epoxy concrete, and a unit weight of 135 pcf. The Contractor shall furnish suitable measuring devices to assure correct proportioning of Materials and accurate measurement for calculating payment quantities. The payment quantity shall be the calculated quantity of polyester/epoxy concrete used in the Work, exclusive of Material used in trial overlay and any wasted or unused Material. Payment quantity will include patches.

The Contract price paid per cubic yard for polyester/epoxy concrete shall include full compensation for furnishing all labor, Materials, tools, Equipment, Incidentals, and for doing all the Work involved in placing polyester/epoxy concrete, including furnishing methacrylate resin prime coat and furnishing Materials for trail overlays, removal of unsound concrete and preparation of repair areas when polyester/epoxy concrete is used as the patching Material, and as shown on the Plans, as specified in the Standard Specifications and as directed by the Project Manager.

Removal of loose concrete and preparation of repair areas for patching Material other than polyester/epoxy concrete will be measured by the square yard in accordance with Section 533, "Concrete Structure Repair."

537.5 BASIS OF PAYMENT

The Accepted quantities, measured as provided above, will be paid for at the Contract price per unit of measurement for the pay items listed below that are shown in the proposal. Payment will be full compensation for the Work described in this Section.

Pay Item	Pay Unit
<i>Polyester/Epoxy Concrete Bridge Deck Overlay</i>	Cubic Yard

537.5.1 Work Included in Payment

The following Work and item(s) will be considered as included in the payment for polyester/epoxy concrete and will not be measured or paid for separately:

1. ICRI concrete surface profile chips;

2. Surface preparation; and
3. Technical representative.

SECTION 540: STEEL REINFORCEMENT

540.1 DESCRIPTION

This Work consists of providing and placing steel reinforcement.

540.2 MATERIALS

540.2.1 Bar Reinforcement

The Contractor shall provide deformed bars in accordance with AASHTO M 31, Grade 60, or ASTM A706, Grade 60, at the nominal dimensions in accordance with Table 540.2.1:1, "Nominal Dimensions of Reinforcement." AASHTO M31 Grade 40 may be used for Reinforced Concrete for Minor Structures (Section 515 only).

**Table 540.2.1:1
Nominal Dimensions of Reinforcement**

Bar size	Nominal Weight (lb/ft)	Diameter (inch)
No. 3	0.376	0.375
No. 4	0.668	0.500
No. 5	1.043	0.625
No. 6	1.502	0.750
No. 7	2.044	0.875
No. 8	2.670	1.000
No. 9	3.400	1.128
No. 10	4.303	1.270
No. 11	5.313	1.410
No. 14	7.650	1.693
No. 18	13.600	2.257

540.2.2 Welded Wire Fabric

The Contractor shall provide welded wire fabric in accordance with AASHTO M 55.

540.2.3 Spiral Reinforcement

The Contractor shall provide spiral reinforcement fabricated from steel bars in accordance with AASHTO M 31, or from cold drawn steel wire in accordance with the AASHTO M 32.

540.2.4 Reinforcing Wire

The Contractor shall provide reinforcing wire in accordance with AASHTO M 32.

540.2.5 Corrosion-resistant and Coated Reinforcing Bars

The Contractor may use one (1) of the following corrosion-resistant or coated reinforcement systems for Bridge decks and other concrete components exposed to weather and Road salts:

1. Epoxy-coated reinforcement in accordance with ASTM A775 and from plants certified by the Concrete Reinforcing Steel Institute (CRSI) for the coating and fabrication process;
2. Deformed stainless steel bars in accordance with ASTM A 955;

3. Stainless steel clad deformed steel bars in accordance with AASHTO M 329;
4. Uncoated low-carbon, chromium, steel bars in accordance with AASHTO MP 18 ; or
5. Hot-dipped galvanized reinforcement in accordance with ASTM A767.

540.2.6 Coating and Patching Materials

The Contractor shall provide the following coating and patching Materials:

1. A fusion-bonded powdered epoxy resin coating Material that meets the requirements of ASTM A 775.
2. A liquid, two (2) part epoxy patching Material formulated to be compatible with the fusion-bonded epoxy powder coating, to repair damaged or uncoated areas. The patch Material shall meet the requirements of ASTM A775 Annex A2.
3. Zinc-rich paint with a minimum 65% zinc content in accordance with ASTM A780 for patching damaged and uncoated areas of hot-dip galvanizing.

540.2.7 Accessories

The Contractor shall provide plastic-coated reinforcing tie wire for tying epoxy-coated reinforcing bars, for deformed stainless steel bars, for stainless steel clad deformed steel bars and for uncoated low-carbon, chromium, steel deformed bars. The Contractor shall provide galvanized, annealed wire tires for galvanized reinforcing bars.

The Contractor shall provide continuous chairs or supports which shall be one (1) of the following types of chairs, supports, and clips:

1. Steel, fully coated with plastic or fusion-bonded epoxy.
2. Galvanized steel, with the cradle and the upper two (2) inches of the chair, support, or clip, coated with fusion-bonded epoxy or plastic.
3. Galvanized metal chairs or other metal supports for reinforcement that contacts the exposed concrete surfaces.
4. Galvanized, painted or epoxy-coated metal chairs or other corrosion resistant metal supports for regular reinforcement.
5. Epoxy coated metal chairs or other corrosion resistant metal supports for epoxy-coated reinforcement.
6. Galvanized sand chairs or other metal supports placed directly on the ground; or
7. Concrete blocks in place of sand chairs or other metal supports placed directly on the ground.

The Contractor shall not use uncoated black (ferrous) steel ties, chairs, supports or clips in direct contact with stainless or galvanized reinforcing.

540.2.8 Certificates of Compliance

The Contractor shall provide Certificates of Compliance to the Project Manager with each reinforcing steel shipment.

The Contractor shall show the Project number, the shipping invoice number, name of the manufacturer, pounds shipped, heat numbers, Laboratory test reports, and grade of steel on the Certificates of Compliance. This requirement is the same for each of the coating/cladding systems and the corrosion-resistant systems.

540.2.9 Epoxy-Coated Reinforcing Bar Certificates of Compliance

The Contractor shall submit evidence that the epoxy-coated reinforcing steel furnished for this Project was produced by a plant that is currently Certified by the CRSI.

The Contractor shall provide the Department's Inspector three (3) copies of a Certificate of Compliance for each shipment of coated bars. The Contractor shall state on the certificate that the samples of the coated bars were tested and that the test results were in accordance with ASTM A 775 and this specification. The Contractor shall show epoxy resin batch numbers on the certificate.

The Contractor shall provide coating test results to the Department for inclusion in final inspection reports.

540.2.10 Epoxy-Coated Reinforcing Coating

Epoxy coating shall be applied by the electrostatic spray method or other organic coating methods that meet the requirements of ASTM A 775.

The Contractor shall provide epoxy coated reinforcing steel that is produced by a plant that is currently Certified by the CRSI.

540.2.11 Hot-Dip Galvanized Reinforcing Bars

The Contractor shall provide hot-dip galvanized reinforcing bars in accordance with ASTM A 767. The Contractor shall galvanize bar after cutting and bending.

540.2.12 Galvanizing Material

The Contractor shall provide galvanizing zinc in accordance with ASTM B6.

540.3 CONSTRUCTION REQUIREMENTS

540.3.1 GENERAL

The Contractor shall measure dimensions from centerline of bar to centerline of bar.

The Contractor shall store all reinforcing bars above ground on platform skids or other supports. Reinforcing shall be kept free from dirt, grease, and other foreign matter. Reinforcing shall be kept free of corrosion as far as practicable.

540.3.1.1 Bar Lists and Bending Diagram

When the Contract documents do not include detail bar lists and bending diagrams, the Contractor shall provide such list and diagrams to the State Bridge Engineer for review and approval. The approval of bar lists and bending diagrams shall in no way relieve the Contractor of responsibility for correctness. The bar lists and bending diagrams shall meet the requirements of the current edition of the Concrete Reinforcing Steel Institute's (CRSI) publication Reinforcing Bar Detailing. The Contractor shall allow 30 Days for review of the submittal.

540.3.1.2 Bundling and Tagging

The Contractor shall tag and mark reinforcement bar shipments in accordance with CRSI's *Code of Standard Practice*.

540.3.1.3 Bar Bending

The Department will allow cold bending around a pin. The Contractor shall not field bend Grade 60 bars, epoxy-coated bars or hot-dip galvanized bars.

Unless otherwise directed, the Contractor shall ensure the bend diameter is in accordance with CRSI Manual of Standard Practice current edition.

540.3.1.4 Splicing

The Contractor shall splice bars only in accordance with the Plans unless otherwise approved by the State Bridge Engineer.

The Contractor shall place and tie bars in lapped splices to maintain minimum reinforcing cover.

The Contractor shall splice spiral reinforcement by lapping. The Contractor shall ensure that laps are at least 48 bar or wire diameters, but not less than one (1) ft with 90° hooks around longitudinal bars at ends.

The Department will allow mechanical couplers for AASHTO M 31, Grade 60, and ASTM A706, Grade 60. Mechanical coupler splice strength must be greater than or equal to 125% of the yield strength of the spliced reinforcing bars and must develop the specified tensile strength of the bars. ACI 318 "Type 2" mechanical couplers meet the above splice strength requirements. The Contractor shall submit coupler type (manufacturer and model number) and certified test results from an approved testing agency showing that the coupler meets these requirements.

If the mechanical couplers are included in the Contract Documents, the method of payment for couplers shall be by the each. If the mechanical couplers are not included in the Contract Documents but are requested for the convenience of the Contractor, payment shall be incidental to the reinforcing bar pay item.

If the mechanical couplers are not included in the Contract documents, the Contractor may submit documentation to the Project Manager for showing where mechanical couplers are proposed to be used. The Contractor shall show splice locations and coupler clearance dimensions in the request and submit before fabricating the reinforcing bars that will be coupled. The Contractor shall allow 14 Days for review and approval of submittals.

Unless otherwise specified, the Contractor shall ensure that welded wire fabric and bar-mat reinforcement overlap is at least one (1) spacing of cross wires plus two (2) inches when measured between the outer-most cross wires of each sheet.

540.3.1.5 Field Cutting

Bars may be cut to length in the field by shearing or sawing. Flame cutting will not be permitted. The ends of coated or clad bars cut in the field shall be patched with suitable patching Material.

540.3.1.5.1 Reinforcing Bar Placement

The Contractor shall place reinforcing bars as shown in the Contract drawings, securely tied in position with wire not smaller than 16 gauge. The Contractor shall carefully place, support and tie reinforcing, and place and consolidate concrete around reinforcing with care to avoid any displacement and damage to the coatings.

The Contractor shall tie all intersections where bar spacing is greater than or equal to one (1) ft in either direction. The Contractor shall tie alternate intersections where bar spacing is less than one (1) ft in either direction.

The Contractor shall use metal spacers, chairs, hangers, and other approved devices to hold the reinforcing bars in position.

When using concrete blocks to support the bottom mat of reinforcement in slabs that are cast on ground, the Contractor shall use dense, rectangular concrete blocks that:

1. Have compressive strength and density equal to or greater than the concrete to be placed;
2. Occupy a small area; and
3. Contain embedded, plastic or epoxy-coated, tie wires for attachment of reinforcement.

The Contractor shall not use wooden spacers or supports.

Tie reinforcing bar mats in Bridge deck and concrete box Culvert slabs to beams and forms to prevent upward movement during concrete placement. The Contractor shall ensure that the space between ties does not exceed ten (10) ft.

540.3.1.5.2 Reinforcing Bar Placement Tolerances

The Contractor shall ensure that the space between adjacent bars does not vary more than the greater of ½ inch or 1/24 of the spacing dimension shown on the Plans.

Except for slabs cast on the ground, the Contractor shall ensure that the clear cover of reinforcement shall not vary more than the greater of either 1/4 inch or 1/8 of the dimension shown on the Plans.

The Contractor shall ensure that the reinforcement clear cover in slabs cast on the ground does not vary more than minus 1/2 inch from the position shown on the Plans.

540.3.1.6 Cleaning Reinforcing Bars

Before placing concrete, the Contractor shall clean the reinforcing bars of Materials that would reduce or destroy the bond.

540.3.1.7 Welding of Reinforcing Steel

The Contractor shall weld reinforcing steel only if the Contract requires it or if the State Bridge Engineer authorizes it in writing. The Contractor shall weld in accordance with AWS Specification D1.4, Reinforcing Steel Welding Code. Welding of bars other than ASTM A706 is allowed only upon approval of qualified welding procedures for those bars that comply with AWS D1.4. The Contractor shall submit a Welding Procedure Specification, stamped by an AWS certified welding Inspector for each procedure.

Welding reinforcing to other steel added by the Contractor for stiffening, cage alignment, lifting, handling and other Contractor needs shall not be allowed unless called for in the Plans.

540.3.1.8 Concrete Cover Requirements

Concrete cover is the distance from the surface of concrete to the edge of the bar nearest to that surface. If cover dimensions are not specified in the Contract, the Contractor shall use the concrete cover dimensions in accordance with Table 540.3.1.8:1, "Concrete Cover Requirements."

**Table 540.3.1.8:1
Concrete Cover Requirements**

Location	Minimum Cover (inch)
Concrete cast against and permanently exposed to the ground	3
Concrete exposed to the ground or weather	
Principal reinforcement	2
Stirrups, ties and spirals	1 ½
Concrete Bridge slabs	
Top reinforcement	2
Bottom reinforcement	1
Concrete not exposed to weather or in contact with ground	
Principal reinforcement	1 ½
Stirrups, ties and spirals	1
Bar bundles	2 ^a
^a Or equal to the diameter of a single bar of equivalent area, whichever is greater.	

540.3.1.9 Final Inspection

The Contractor shall not place concrete until the Department inspects and accepts the reinforcing steel in place.

Acceptance of the reinforcing steel does not relieve the Contractor of responsibility for the cover and position control of the steel.

540.3.2 Requirements for Epoxy-Coated Reinforcing Bars

540.3.2.1 Storage and Handling of Epoxy-Coated Reinforcing Bars

The Contractor shall transport and store epoxy-coated reinforcing steel on wooden or padded supports. The Contractor shall use devices with padded contact areas to handle epoxy-coated reinforcement bars and prevent bar-to-bar abrasion. The Contractor shall not drop or drag bars or bundles. The Contractor shall use spreader beams and multiple pick points when hoisting bar bundles to prevent sagging. The Contractor shall not store epoxy-coated reinforcing bars in sunlight for more than 30 Days. The Contractor shall use only non-metallic sleeved heads with immersion-type vibrators when placing concrete around epoxy-coated reinforcing.

540.3.2.2 Repair of Damaged Epoxy-Coating

The Contractor shall repair visible damage before shipping. The Contractor shall ensure the total surface area of patched coating Material is not more than one percent (1%) of the total coated area in any one (1) foot section. The Department will reject bars shipped to the Project that show more than one percent (1%) patched coating Material.

The Contractor shall patch sheared ends, cuts and exposed areas promptly before detrimental oxidation occurs. The Contractor shall keep exposed areas free of contaminants before patching.

The Contractor shall patch coating damage before placing concrete. The Contractor shall ensure that the total patched surface area does not exceed two percent (2%) of the coated area in any one (1) foot section. The Department will reject any installed bars with more than two percent (2%) patching.

The Contractor shall apply the patching Material in strict compliance with the manufacturer's instructions. The Contractor shall allow adequate time for the patch to cure before placing concrete over the bars.

540.3.3 Requirements for Galvanized Reinforcing Bars

540.3.3.1 Galvanizing Bent Bars

Where galvanized bars are detailed to be bent or have other types of cold-forming, the bars must be bent before galvanizing.

540.3.3.2 Surface Preparations

The Contractor shall prepare bar surfaces by removing dirt and grease with a hot alkaline solution. The Contractor shall use a diluted solution of sulfuric acid to pickle. The Contractor shall use a solution of zinc ammonium chloride to flux. The Contractor shall ensure that the resulting surface condition is equal to SSPC-SP 10 as described by the SSPC.

540.3.3.3 Thickness of Galvanizing

The Contractor shall ensure that the galvanizing after drying with air, steam or wiping is from three (3) mils to 3.9 mils thick. The Contractor shall determine the thickness with a magnetic thickness gage.

540.3.3.4 Chromating

The Contractor shall treat the galvanized coating with chromate. This prevents a reaction between the bars and fresh Portland cement paste. The Department will allow proprietary chromating treatment solutions of equivalent strength instead of the generic chemical treatment in accordance with ASTM A 767, Section 5.3. Quenching of bent bars or bars to be bent is not allowed. Such bars must be chromated at ambient temperature.

540.3.3.5 Finish and Adherence of Coating

The Contractor shall ensure that the zinc coating is free of bare spots, blisters, flux spots or inclusions, dross, and acid or black spots. The Department will reject bars that stick together after galvanizing. A matte gray finish appearance is not, by itself, a cause for rejection.

The Contractor shall ensure that the coating cannot be removed through normal handling.

540.3.3.6 Installation of Galvanized Reinforcing Bars

The Contractor shall transport and store galvanized bars in a manner to prevent damage to the galvanized coating. All systems for handling galvanized coated bars shall have padded

contact areas. All bundles of bars shall be lifted using spreader beams and multiple pick points or a platform Bridge to prevent bar-to-bar abrasion from sagging in the bar bundle. The bars and bundles shall not be dropped or dragged on the ground, platforms or other bars.

Galvanized reinforcing bars shall not be tied with black steel or left in contact with black steel. Galvanized reinforcing bars shall be left in contact only with galvanized, plastic-coated, or epoxy-coated surfaces.

540.3.3.7 Repair of Damaged Galvanizing

The Contractor shall patch sheared ends, cuts and exposed areas using a zinc-rich paint in accordance with ASTM A780. The Contractor shall prepare the surface to be patched so that it is clean, dry and free of oil, grease and corrosion products. The Contractor shall blast-clean the surface to near-white metal, in accordance with SSPC-SP10. The Contractor shall spray or brush-apply the paint containing the zinc dust as recommended by the manufacturer in one (1) application of as many passes as required to achieve a dry film thickness of four (4) mils as determined using a magnetic or electromagnetic gage.

540.3.4 Repair of Stainless Steel Clad Deformed Steel Bars

The stainless steel clad deformed steel bars shall be shop bent as shown on the Contract documents using tools with non-ferrous surfaces that will not contaminate stainless steel cladding with ferrous particles. All ends of the bars where mild steel core is exposed shall be capped by one (1) of the following methods:

1. Heat shrink cap applied in accordance with the cap manufacturer's instructions.
2. Neoprene cap adhered with silicone or epoxy sealant.
3. Stainless steel cap epoxied in place.
4. Stainless steel seal weld.

No field cutting or bending of stainless steel clad deformed steel bars will be allowed.

540.4 METHOD OF MEASUREMENT

The Department will measure reinforcing bar weight in accordance with Table 540.2.1:1, "Nominal Dimensions of Reinforcement," whether it is black steel, epoxy-coated, galvanized, stainless steel, stainless steel clad, or low-carbon, chrome steel. The computed weights of reinforcing bars will be based on the nominal weights of the bars before application of the epoxy-coating, or galvanizing of the bars. Lap splices shown in the Contract documents shall be included in computing the weight of the bars for payment. For CBC construction, lap splice weight shall be included in computing the weight of the bars for payment when phased construction is required by the Contract documents and when maximum run lengths exceed 60 feet. When lap splices are unscheduled or are made for the convenience of the Contractor and are approved by the Project Manager at locations not shown in the Contract, the extra steel required for lap splices will not be included in computing the weight of the bars for payment. Mechanical couplers that are shown in the Contract documents or are required for construction shall be paid for by "Each." When mechanical couplers are installed for the convenience of the Contractor and are approved by the State Bridge Engineer at locations not shown in the Contract, the mechanical couplers will not be paid for.

540.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Reinforcing Bars, Grade _____	Pound

<i>Epoxy-Coated Reinforcing Bars, Grade _____</i>	Pound
<i>Galvanized Bars, Grade _____</i>	Pound
<i>Uncoated Corrosion Resistant Reinforcing Bars, Grade _____</i>	Pound
<i>Stainless Steel Reinforcing Bars, Grade _____</i>	Pound
<i>Stainless Steel Clad Reinforcing Bars, Grade _____</i>	Pound
<i>Mechanical Couplers</i>	Each

540.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Clips, supports, wire, and other Material used for fastening reinforcement;
2. Samples and submittals; and
3. Mechanical couplers and reinforcing bar lap splices that are installed for the convenience of the Contractor.

SECTION 541: STEEL STRUCTURES

541.1 DESCRIPTION

This Work consists of providing, fabricating, erecting, and coating Structural Steel.

Structural Steel includes forged or cast steel, bolts, tie rods, other ferrous or nonferrous Materials, and miscellaneous steel. Steel shall be divided into the following categories:

Tier 1 – rolled steel beams, plate girders, diaphragms and cross frames for steel Bridges, and overhead sign Structures.

Tier 2 – metal Bridge barrier rails, diaphragms for concrete Bridges, and steel bearing components.

Tier 3 – drop inlets, safety grates, cattle and game guards, pedestrian rails, gates, access panels, and other miscellaneous steel.

For welding of driven pile splices, see Section 541.3.6.4, "Field Welding."

541.2 MATERIALS

541.2.1 Structural Steel

The Contractor shall provide Structural Steel in accordance with AASHTO M270, Grade 50, unless otherwise designated in the Contract. The Contractor shall provide steel for anchor bolts, sole plates, minor Bridge components, inlet grates, and cattle guards in accordance with AASHTO M270, Grade 36 or Grade 50.

541.2.1.1 Impact Testing Requirements for Non-Fracture-Critical Structures

For Materials requiring impact testing, the Contractor shall not weld repair the base metal at the producing mill. The Department will consider Structures to be non-fracture-critical, unless otherwise designated in the Contract. The Contractor shall fabricate the following in accordance with AASHTO M270, Table 10 when subject to tensile stresses:

1. Wide flange beams used as main load carrying members;
2. Flanges and web plates used in plate girders;
3. Flange cover plates;
4. Flange and web splice plates; and
5. Other components designated in the Contract.

The Contractor shall conduct Charpy V-notch (CVN) impact "H" or "P" frequency testing in accordance with AASHTO T243.

The Contractor shall ensure that Structural Steel meets requirements for minimum service temperatures as described for Zone 2 of the AASHTO's *Standard Specifications for Highway Bridges* (negative one degrees (-1°)F – 30°F).

The Contractor shall conduct plate-frequency testing instead of hat-lot testing for plate Material thicker than 1-1/2inch.

541.2.1.2 Impact Testing Requirements for Fracture-Critical Bridge Components

The Contract will specify the CVN requirements for fracture-critical Bridge components.

541.2.2 Shear Connector Studs

The Contractor shall provide shear connector studs fabricated from cold-drawn bars, grades 1015, 1018, or 1020, either semi-killed or fully-killed in accordance with AASHTO M169.

If using flux-retaining caps, the Contractor shall use the low carbon grade steel for the caps that is suitable for welding and in accordance with ASTM A109. The Contractor shall produce the finish by cold drawing, cold rolling, or machining.

The Contractor shall ensure stud tensile properties are in accordance with Table 541.2.2:1, "Tensile Properties of Shear Connector Studs," as determined by tests of bar stock (after drawing) or finished studs, in accordance with ASTM A370.

**Table 541.2.2:1
Tensile Properties of Shear Connector Studs**

Property	Minimum Requirement
Tensile strength	60,000 psi
Yield strength @ 0.2% offset	50,000 psi
Elongation in two (2) inch	20%
Reduction of area	50%

The Contractor shall weld studs with automatic stud welding guns that shall be used to weld studs to girders. The operator shall be qualified per AWS D1.5 Subsection 7.7.4. The base metal where the stud is to be welded shall be ground to bright metal immediately prior to the weld being made. Manual welding will not be allowed except to make repairs. Repairs shall be in accordance with AWS D1.5 Subsection 12.6. Repair fillet size shall be a minimum of 5/16 inch.

541.2.3 Aluminum

The Contractor shall provide aluminum and aluminum alloy Materials in accordance with ASTM aluminum alloy designation and in accordance with the Plans.

541.2.4 Bolts

The Contractor shall provide high-strength bolts in accordance with Section 542, "High-Strength Bolts." The Contractor shall provide other bolts in accordance with ASTM A307, Grade A.

541.2.4.1 Unfinished Bolts

The Contractor shall provide unfinished ASTM A307 bolts. The Contractor shall provide thread bolts so that not more than two (2) threads are within the grip of the connected parts. The Contractor shall use bolts that will extend beyond the nut at least two (2) threads, but not more than 1/2 inch.

541.2.5 Structural Steel Coating

The Contractor shall provide coated Structural Steel in accordance with Table 541.2.5:1, "Coating of Structural Steel."

**Table 541.2.5:1
Coating of Structural Steel**

Item	Coating Requirement
Galvanizing, Hot-Dip Galvanizing, or Zinc Coating	Section 541.2.5.1
Structural Steel for Steel Bridges	Section 544, "Protective Coating of New Structural Steel"
Structural Steel for Concrete Bridges	Section 544, "Protective Coating of New Structural Steel"
Structural Steel for Miscellaneous Structures	Section 545, "Protective Coating of Miscellaneous Structural Steel"
Metal Bridge Railing	Section 545, "Protective Coating of Miscellaneous Structural Steel"
New Exposed Steel Bridge Piling and Similar Applications	Section 545, "Protective Coating of Miscellaneous Structural Steel"
Recoating Bridges	Section 546, "Recoating Structures"

541.2.5.1 Galvanizing or Zinc Coating

If the Contract requires a galvanized coating, the Contractor shall coat steel after fabrication in accordance with AASHTO M111.

Bolts, washers, nuts, and position dowels used in the assembly and erection of galvanized railing and posts or where specified, shall be galvanized in accordance with AASHTO M232 Class C or shall be zinc coated in accordance with ASTM B695.

After erecting the steel, the Contractor shall coat the galvanized hardware with a product meeting ASTM A780, Type 2.

541.2.5.1.1 Quality Control and Repair of Galvanizing

Uncleaned slag lines, bare spots, blisters, flux spots or inclusions, dross, acid, or black spots that exceed one (1) square inch or occur on more than five percent (5%) of the exposed surface area shall be cause for rejection of the lot. The Materials may be stripped, regalvanized, and again submitted for inspection; otherwise the entire lot shall be rejected.

Pieces with damage to less than five percent (5%) of the exposed surface area may, with the approval of the Project Manager, be repaired in accordance with ASTM A780 Type 1 - zinc-based solders which includes low melting point zinc alloy repair rods or powders or Type 3 - metallizing.

With the approval of the Project Manager, on areas that are concealed from direct weathering and on areas that are not aesthetically visible to the travelling public, ASTM A780 Type 2 (paints containing zinc dust, commonly referred to as "cold galvanizing") may be used on areas less than one square inch and less than five percent (5%) of the exposed surface area. The dried film must contain no less than 90% pure zinc. Surface preparation and application shall be in accordance with the manufacturer's requirements.

In any case, galvanizing repair shall not compromise the aesthetic Acceptability of the Project as determined by the Project Manager.

541.3 CONSTRUCTION REQUIREMENTS

541.3.1 Applicable Codes and Documents

The Contractor shall fabricate and erect steel Structures in accordance with the current edition of the following codes and documents:

1. AASHTO/AWS D1.5 – *Bridge Welding Code*;
2. AASHTO/AWS D1.1 – *Structural Welding Code*;
3. AWS D1.4 – *Structural Welding Code – Reinforcing Steel*;
4. AISC 204 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers; and
5. The following AASHTO/NSBA Steel Collaboration documents:
 - 5.1. *S2.1 Steel Bridge Fabrication Guide Specification*;
 - 5.2. *S 4.1 Steel Bridge Fabrication QC/QA Guide Specification*;
 - 5.3. *S10.1 Steel Bridge Erection Guide Specification*;
 - 5.4. *G 1.1 Shop Detail Drawing Review / Approval Guidelines*;
 - 5.5. *G 1.3 Shop Detail Drawing Presentation Guidelines*; and
 - 5.6. *G12.1 Guidelines to Design for Constructability*.

Although the AASHTO/AWS Steel Collaboration documents are titled “Guidelines” or “Guide Specifications,” consider them to have the same importance and standing as a code or a Specification. If the content of the collaboration documents appears permissive with words such as “should,” “could,” “may,” etc., consider the content to be a requirement unless otherwise approved by the State Bridge Engineer.

In the event of a conflict between a referenced code and this Specification, this Specification will take precedence.

In AASHTO/NSBA Steel Bridge Collaboration S 4.1, all references to Quality Assurance Inspector (QAI) shall be equivalent to referencing the Project Manager.

541.3.2 Quality Control and Quality Assurance (Contractor)

Quality Control and Quality Assurance shall be in accordance with the following:

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification.

Tier 2 – NMDOT Approval of fabrication shop is required, AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition shall be used as the basis for approval (AISC Certification is not required).

Tier 3 – NMDOT Approval of fabrication shop is required, AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition shall be used as the basis for approval (AISC Certification is not required).

Fabricators shall contact the State Bridge Engineer to request shop inspection and approval.

541.3.2.1 Qualification of QA Inspector (NMDOT Representative)

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification, Part C is superseded by the following requirement: current AWS Welding Inspector Certification.

Tier 2 – Licensed Professional Engineer or a certified AWS Welding Inspector.

Tier 3 – Project Manager or a certified AWS Welding Inspector.

The individual qualified for steel inspection shall also perform coating inspections with no further qualification with the exception of Tier 2 which may be performed by the Project Manager or certified AWS Welding Inspector. AASHTO/NSBA Steel Bridge Collaboration, S 4.1 Steel Bridge Fabrication QC/QA Guide Specification 3.2 and 8.1.2 shall not apply to the QAI inspector of coatings.

541.3.3 Submittals

For Tier 1, prior to installation, the Contractor shall provide all submittals in accordance with Section 106, "Control of Materials." Additional required submittals follow but are not limited to:

1. Structural Steel Mill Test Reports (MTRs);
2. Certificates of Compliance and other documentation for the protective coating;
3. The manufacturer's Certificate of Compliance for welding consumables;
4. QC inspection reports; and
5. A general Certificate of Compliance for the fabricated product.

The Contractor shall submit Certificates of Compliance instead of MTRs for Materials subjected to minimal stress levels, such as sole plates, shoe plates, anchor bolts, and fill plates.

541.3.3.1 Working Drawings

The Contractor shall allow 30 Days for review and Acceptance of Working Drawings and calculations. Any re-submittals will require an additional 14 Days for review. The Working Drawing submittal process must be complete prior to the Pre-Fabrication Conference (Section 541.3.5.1, "Pre-Fabrication Conference").

The Contractor shall prepare Working Drawings in accordance with AASHTO/NSBA G 1.3, Shop Detail Drawing Presentation Guidelines. The Department will review Working Drawings for Acceptance in accordance with AASHTO/NSBA G 1.1, Shop Detail Drawing Review / Approval Guidelines. The Working Drawing submittal shall include a detailed bill-of-Material in accordance with AASHTO/NSBA Steel Bridge Collaboration G 1.1 with the letter of intent to fabricate. The Contractor shall submit Working Drawings electronically in PDF format to the Project Manager.

The Contractor shall not make any changes to Accepted Working Drawings. If changes are made, the Contractor shall re-submit the Working Drawings for Acceptance.

The Contractor shall include the submittal and review time for its shop drawings and schedule for fabrication of the specialized structural steel components as a milestone per Section 108.3.1.1, "CPM Baseline Schedule" (bullet 5).

541.3.3.2 Working Drawings for Structural Steel Items Detailed on Standard Drawings

The Contractor may submit standardized Working Drawings instead of Project-specific drawings for Structural Steel items such as cattle guard grills and drop inlet grates.

The Contractor shall include the Fabricator's name and address, drawing title, drawing number, drawing date, revision dates, and Standard Drawing number on Working Drawings.

541.3.3.3 Erection Plan

The Contractor shall submit an erection Plan for Tier 1 steel. Erection Plans are not required for OH Sign Structures.

The Contractor shall submit an Erection Plan conforming to Section 2 of the AASHTO/NSBA Steel Bridge Erection Guide Specification S10.1, 2014 Edition and the following Department requirements:

1. The Erection Plan shall be prepared by a Professional Engineer licensed in the State of New Mexico and shall be accompanied by calculations verifying the safety of all aspects of erection;
2. The Erection Plan shall consider the load-bearing capacities of any temporary or permanent Structures used in the erection of the new Bridge, including any need for shoring;
3. The Erection Plan shall be submitted no less than thirty (30) Days prior to any steel erection operations; and
4. All costs for the Erection Plan and shoring of any temporary or permanent Structure used for the erection of the new Bridge shall be considered included in Bid Item 541100 – Structural Steel for Steel Bridges.

The Contractor shall allow 30 Days for review and Acceptance of the erection Plan. Any re-submittals will require an additional 14 Days for review. The erection Plan submittal process must be complete prior to the start of erection.

The Contractor shall include the submittal and review time for its erection Plan and schedule for erection of the specialized structural steel components as a milestone per Section 108.3.1.1, "CPM Baseline Schedule" (bullet 5).

541.3.4 Rolled Girders and Plate Girders

The Contractor shall provide girders to the full length shown in the Plans. Bolted or welded girder splices will not be permitted unless noted otherwise in the Plans.

541.3.5 Fabrication

The Contractor shall ensure that the fabrication shop for Tier 1 steel is certified in accordance with AASHTO/NSBA *Steel Collaboration S2.1, Steel Bridge Fabrication Guide Specification*. The Department will not require AISC certification for fabrication shops fabricating Tier 2 and Tier 3 steel items, but the Department must inspect and approve these shops before fabrication.

Steel will be fabricated in the shop unless otherwise approved by the Project Manager.

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S2.1 Steel Bridge Fabrication Guide

Specification.

Tier 2 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition.

Tier 3 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition.

541.3.5.1 Pre-Fabrication Conference

A Pre-Fabrication Conference is required for Tier 1 steel (a Pre-Fabrication Conference is not required for OH Sign Structures). The Pre-Fabrication Conference shall be held in conjunction with the Pre-Construction Conference. The Pre-Fabrication Conference may be held on an alternate date at the discretion of the Project Manager. The agenda for the Pre-Fabrication Conference shall be based upon S2.1, "Steel Bridge Fabrication Guide Specification."

541.3.5.2 Attachment and Fit of Gussets and Stiffeners

Where welding of gusset plates, stiffeners or other secondary attachments to main structural members would otherwise result in intersections of welds, the Contractor shall clip back the corners of the attachments 1-1/4 inch minimum from the corner in each direction to avoid such intersections.

The Contractor shall terminate welds attaching secondary components to main members 1/4 inch short of the end of the attachments.

If the Plans require bearing stiffeners "finished to bear," the Contractor shall mill or grind the ends and obtain an even bearing against the flange the stiffeners will bear on.

If the Plans require "tight fit" stiffeners, the Contractor shall fit the stiffeners tight against the flange to exclude water after being coated.

541.3.5.3 Straightening of Flanges

At pier bearings, abutment bearings and splices, the Contractor shall straighten girder or beam flanges perpendicular to the webs. At bearings, the Contractor shall straighten flanges before fitting stiffeners. At splices, the Contractor shall straighten flanges before coating and shipment. The Contractor shall not cold bend.

541.3.5.4 Bearing Plates, Pins, and Rollers

541.3.5.4.1 Sole, Masonry, and Shoe Plates

The Contractor shall flatten the top and bottom surfaces of sole masonry and shoe plates to within $\pm 1/32$ inch.

The Contractor shall machine sole plate surfaces that will contact elastomeric bearing pads perpendicular to the direction of expansion.

The Contractor shall machine other expansion surfaces in the direction of expansion.

541.3.5.4.2 Pins and Rollers

The Contractor shall accurately turn pins and rollers to dimensions and ensure that they are smooth, straight, and free of flaws.

541.3.5.4.3 Pin Holes

The Contractor shall bore a two (2) inch diameter hole longitudinally through the center of pins with an eight (8) inch diameter or larger.

The Contractor shall bore pinholes true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise required. The Contractor shall produce the final surface with a finishing cut.

The Contractor shall not vary the outside to outside distance of end holes in tension members and inside to inside distance of end holes in compression members by more than 1/32 inch. The Contractor shall bore holes in built-up members after shop assembly.

541.3.5.4.4 Threads

The Contractor shall ensure that bolt and pin threads are in accordance with Unified Standard Series UNC-ANSI B1.1, Class 2A for external threads and Class 2B for internal threads. The Contractor shall thread pin ends with a diameter of 1 3/8 inch or greater with six (6) threads per inch.

541.3.5.4.5 Surface Finish

The Contractor shall finish the surfaces of bearings, base plates, pins, rollers, and other bearing steel that will come into contact with each other or with concrete in accordance with ANSI B46.1, Surface Roughness, Waviness and Lay.

541.3.5.5 Connections

541.3.5.5.1 Welding

541.3.5.5.1.1 Welder Qualifications

The Contractor shall use annually certified welders or those who provide documentation demonstrating continuing experience in the process. Welder must be qualified for the position the weld is performed in. All welders shall be certified by AASHTO/AWS D1.1 or D1.5 unless otherwise noted in the Contract.

Tier 1 – AASHTO/NSBA Steel Bridge Collaboration, S2.1 Steel Bridge Fabrication Guide Specification (Built-up plates and open rolled-shape structural elements AWS D1.5, welded tubular structural elements in accordance with D1.1)

Tier 2 – AISC Certification Program for Bridge and Highway Metal Component Manufacturers (AISC 204) current edition. The welder shall be AWS D1.1 certified.

Tier 3 – The welder shall be AWS D1.1 certified.

541.3.5.5.1.2 Testing of Complete Penetration Welds

The Contractor shall conduct nondestructive QC radiographic testing on complete penetration welds in accordance with AWS D1.5 or D1.1 (as applicable).

The Department may allow ultrasonic testing as a substitute for radiography. The Contractor shall submit an ultrasonic testing Plan for approval at least 30 Days before the start of fabrication. The Contractor shall provide detailed information about the Fabricator's previous experience with ultrasonic testing and resumes showing the training and experience of persons performing the testing. The Contractor shall not use ultrasonic testing for cases described in Section 6.7.1.1 of the AASHTO/AWS D1.5-Bridge Welding Code.

541.3.5.5.2 Bolted Connections

The Contractor shall bolt with high strength bolts in accordance with Section 542, "High-Strength Bolts."

The Contractor shall make bolt holes 1/16 inch larger than the nominal diameter of the connector, unless otherwise specified.

541.3.5.5.3 Gaps between Ends of Abutting Members

Where the Contract requires abutting milled joints, the Contractor shall ensure there are no gaps. The Contractor shall face the ends to provide a full and even bearing when assembled.

Where the Contract requires close joints, the Contractor shall not exceed 1/8 inch between the ends of abutting members. The Contractor shall not exceed 1/4 inch between abutting ends of girders at splices.

541.3.5.6 Camber Verification

The Contractor shall verify girder camber during the laydown operation. Unless assembling girders in the horizontal position, the Contractor shall meet the total camber dimensions less the deflections produced by the weight of the girder.

541.3.6 Erection Requirements

The Contractor shall erect the Structure in accordance with AASHTO/NSBA Steel Bridge Collaboration S10.1, *Steel Bridge Erection Guide Specification*.

If requested by the Project Manager, a Pre-Erection Conference shall be held prior to start of erection. The agenda shall be the review of the erection Plan.

541.3.6.1 Placement of Bearings

The Contractor shall ensure that column bases and bearing devices bear fully and uniformly on Substructures. The Contractor shall not place bearings on pier or abutment Bridge seat areas that are improperly finished or irregular. The Contractor shall grout to achieve uniform bearing only when the Contract allows grouting.

The Contractor shall place masonry plates and beam and girder span pedestals on impregnated fabric pads approved by the Project Manager at least 1/8 inch thick.

541.3.6.2 Anchor Bolt Holes

The Contractor shall core drill anchor bolt holes in accordance with Table 541.3.6.2:1, "Required Nominal Anchor Bolt Hole Diameters."

**Table 541.3.6.2:1
Required Nominal Anchor Bolt Hole Diameters**

Bolt diameter (inch)	Hole diameter (inch)
3/4	1-1/2
1	1-3/4
1-1/4	2

The Contractor shall set anchor bolts using non-shrink grout from the Department's Approved Products List. The Contractor shall remove excess mortar after the grout has set. The Contractor shall ensure that anchor bolt washers and nuts bear evenly against the steel-bearing surface. The Contractor shall ensure anchor bolts at the expansion ends of spans allow the free movement of the span.

541.3.6.3 Field Bolting

The Contractor shall install high strength bolts in accordance with Section 542, "High-Strength Bolts."

The Contractor shall block main structural members to the desired camber before torquing the bolted splice connections.

For skewed steel Bridges with diaphragms perpendicular to the longitudinal centerline, the Contractor shall finger tighten diaphragm attachment bolts before deck placement. The Contractor shall fully torque bolts after the deck slab is in place.

Following completion of the Superstructure and after priming, the Contractor shall fill open holes in exterior beams and girders with button head bolts before Final Acceptance.

541.3.6.4 Field Welding

Field welding of permanent steel elements will not be permitted unless shown in the Plans, with the following exceptions:

1. Field welds shown in the Plans;
2. Splices for driven pile;
3. Sole plate to girder shoe plate;
4. Pedestrian rails;
5. Shear studs installed in the field for construction means and methods; or
6. As approved by the Project Manager.

541.3.6.4.1 Field Welding Submittal and Qualifications

The Contractor shall submit a welding procedure and the welder's certification for the welder performing the Work. The welder certification must be consistent with the welding procedure and the welding position required to perform the Work. Qualifications of the welders shall be consistent with Section 541.3.5.5.1.1, "Welder Qualifications."

541.3.6.4.2 Field Welding Inspections

The Contractor shall provide a certified AWS Welding Inspector. This Inspector shall review and approve the welding procedure and the welder qualifications. This Inspector shall provide testing and documentation in accordance with Section 541.3.1, "Applicable Codes and

Documents.” Documentation shall be submitted to the Project Manager within Seven (7) Days of completion of the welding activity.

541.3.6.4.3 Field Installation of Shear Studs

Should the Contractor elect to install shear studs in the field, the Contractor shall field weld studs with automatic stud welding guns that shall be used to weld studs to girders. The operator shall be qualified per AWS D1.5 Subsection 7.7.4. The base metal where the stud is to be welded shall be ground to bright metal immediately prior to the weld being made. Manual welding will not be allowed except to make repairs. Repairs shall be in accordance with AWS D1.5 Subsection 12.6. Repair fillet size shall be a minimum of 5/16 inch.

Field welded studs shall be inspected in accordance with Section 541.3.6.4.2, “Field Welding Inspections.”

541.3.6.5 Pilot and Driving Nuts

The Contractor shall use pilot and driving nuts in driving pins. The Contractor shall show details on the Working Drawings. The Contractor shall furnish one (1) pilot and one (1) driving nut for each size pin.

541.3.7—Reserved

541.3.8 Disposal of Steel Structures, Reinforcing Steel, Steel Debris or Steel Waste

The Contractor shall not reuse salvaged steel items from existing Structures on NMDOT Projects unless directed otherwise in the Plans. Salvaged steel shall be disposed of by Contractor as approved by the Project Manager.

541.3.9 Quality Assurance Inspection Frequency

541.3.9.1 Steel Inspections

The following Quality Assurance Inspections shall be performed by the Quality Assurance Inspector (QAI). Unless otherwise noted, the Inspections shall take place in the fabrication shop.

Tier 1 – Rolled steel beams – minimum of one (1) QA Inspections per Project;
Plate girders – minimum of three (3) QA Inspections per Project;
Diaphragms and cross frames – include with the above inspections; and
Overhead sign structures – minimum of one (1) inspection per fabrication shop per year.

Tier 2 – Metal Bridge barrier rails – 40% of welds by length;
Diaphragms for concrete Bridges – visual inspection upon delivery to site; and
Steel bearing components – 40% of welds by length.

Tier 3 – Drop inlets – visual inspection upon delivery to site;
Safety grates – visual inspection upon delivery to site;
Cattle & game guards – visual inspection upon delivery to site;
Pedestrian rails – visual inspection upon delivery to site;
Gates – visual inspection upon delivery to site;
Access panels – visual inspection upon delivery to site; and
Miscellaneous steel – visual inspection upon delivery to site.

It is recommended that a QA Inspection be performed at or near the completion of

erection; this is in addition to those listed above.

541.3.9.2 Coating Inspections for Paint and Powder Coating

The following Quality Assurance Inspections shall be performed by the Quality Assurance Inspector (QAI). Unless otherwise noted, the Inspections shall take place in the fabrication shop. The Project Manager may waive coating inspections.

Tier 1 – Rolled steel beams – one (1) inspection concurrent with a steel inspection;
Plate girders – one (1) inspection concurrent with a steel inspection;
Diaphragms and cross frames – no requirement; and
Overhead sign Structures – photos of coating process shall be provided to the QAI with QC traveler documentation, visual inspection upon delivery to site.

Tier 2 – Metal Bridge barrier rails – two (2) shop inspections are recommended per Project; this may be waived by the Project Manager;
Diaphragms for concrete Bridges – no requirement; and
Steel bearing components – visual inspection upon delivery to site.

Tier 3 – Drop inlets – visual inspection upon delivery to site;
Safety grates – visual inspection upon delivery to site;
Cattle & game guards – visual inspection upon delivery to site;
Pedestrian rails – visual inspection upon delivery to site;
Gates – visual inspection upon delivery to site;
Access panels – visual inspection upon delivery to site; and
Miscellaneous steel – visual inspection upon delivery to site.

It is recommended that a QA inspection be performed at or near the completion of erection; this is in addition to those listed above.

541.3.9.3 Galvanized Elements

Galvanized elements shall be visually inspected upon delivery to the site by the Project Manager.

541.4 METHOD OF MEASUREMENT

If structural members are specified by a nominal unit weight, the Department will calculate weight based on the nominal weights and dimensions.

When structural members are not designated by a nominal unit weight, the Department will calculate weight using the unit weights listed in Table 541.4:1, "Metal Unit Weights for Measurement."

The Department will deduct the weight of copes, cuts, bevels, and open holes from the gross weight. The Department will not make deductions for bolt holes.

**Table 541.4:1
Metal Unit Weights For Measurement**

Material	Unit weight (lb./ft³)
Steel	490
Cast iron	445
Bronze	536

541.4.1 Bolts

The Department will pay the weight of fasteners as indicated on the Accepted Working Drawings.

541.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Structural Steel for Concrete Bridges</i>	Pound
<i>Structural Steel for Steel Bridges</i>	Pound
<i>Structural Steel for Miscellaneous Structures</i>	Pound

541.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Submittals including re-submittals;
2. Nondestructive testing;
3. Protective coatings;
4. Additional weight of heavier sections provided solely for the Contractor's convenience;
5. All Incidentals necessary for the completion of the Work;
6. Weld Material weight; and
7. All QC/QA requirements.

SECTION 542: HIGH-STRENGTH BOLTS

542.1 DESCRIPTION

This Work consists of providing and installing high-strength bolts.

542.2 MATERIALS

When the Contract requires galvanized fasteners, the Contractor shall mechanically galvanize in accordance with ASTM B 695, Class 50.

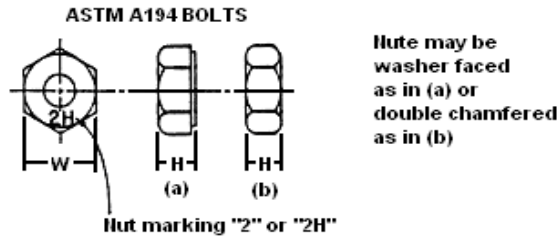
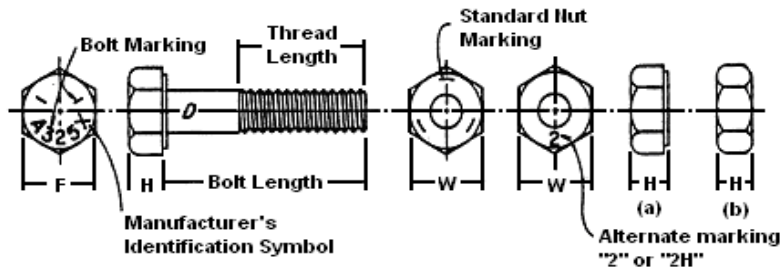
The Contractor shall mark bolts, nuts, and washers in accordance with the applicable AASHTO or ASTM Specifications.

542.2.1 Bolts

The Contractor shall provide headed bolts in accordance with ASTM F 3125. The Contractor shall ensure that bolt dimensions are in accordance with ANSI B 18.2.1 and nut dimensions are in accordance with ANSI B 18.2.2. These dimensions are tabulated in Table 542.2.1:1, "Dimensions of High-Strength Bolts." For dimension labels, the Contractor shall refer to Figure 542.2.1:1, "ASTM F 3125 Bolts."

The Contractor shall ensure that hardness for bolts with diameters from 1/2 inch to one (1) inch is in accordance with Table 542.2.1:2, "Bolt Hardness Requirements."

**Figure 542.2.1:1
ASTM F 3125 Bolts**



**Table 542.2.1:1
Dimensions of High-Strength Bolts**

Nominal bolt size, D	Heavy hex structural bolts			Heavy hex nuts	
	Width across flats, F	Height, H	Thread length	Width across flats, W	Height, H
1/2	7/8	5/16	1	7/8	31/64
5/8	1 1/16	25/64	1 1/4	1 1/16	39/64
3/4	1 1/4	15/32	1 3/8	1 1/4	47/64
7/8	1 7/16	35/64	1 1/2	1 7/16	55/64
1	1 5/8	39/64	1 3/4	1 5/8	63/64
1 1/8	1 13/16	11/16	2	1 13/16	17/64
1 1/4	2	25/32	2	2	17/32
1 3/8	2 3/16	27/32	2 1/4	2 3/16	1 11/32
1 1/2	2 3/8	15/16	2 1/4	2 3/8	1 15/32

Note: All dimensions in inches

**Table 542.2.1:2
Bolt Hardness Requirements**

Bolt diameter	Hardness number			
	Brinnell		Rockwell C	
	Minimum	Maximum	Minimum	Maximum
1/2 inch–1 inch	248	311	24	33

The Contractor shall use Table 542.2.1:3, "Bolt Lengths," to determine bolt lengths by adding the values shown to the grip. Grip is the total thickness of all connected material, exclusive of washers.

**Table 542.2.1:3
Bolt Lengths**

Bolt size	Length to be added to grip
1/2	1 1/16
5/8	1 3/16
3/4	1 3/8
7/8	1 9/16
1	1 3/4
1 1/8	1 7/8
1 1/4	2
1 3/8	2 1/8
1 1/2	2 1/4

Note: All dimensions in inches

These values are based on using one (1) hardened flat washer and one (1) direct tension indicator.

When using beveled washers, the Contractor shall subtract the thickness of a flat washer and add 5/16 inch for the beveled washer. The Contractor shall adjust the length in

accordance with Table 542.2.1:3, "Bolt Lengths," to the next longer 1/4 inch.

542.2.2 Nuts

The Contractor shall provide nuts in accordance with ASTM A 563 with dimensions in accordance with ANSI B 18.2.2 and Table 542.2.1:1, "Dimensions of High-Strength Bolts."

The Contractor shall ensure plain (ungalvanized) nuts are of grades 2, C, D, or C3 with a minimum Rockwell B hardness of 89 or Brinell hardness of 180, or heat-treated grades 2H, DH, or DH3.

The Contractor shall provide heat-treated, grade 2 galvanized nuts. The Contractor shall provide mechanically galvanized nuts in accordance with ASTM B 695, Class 50. The Contractor shall overtap nuts before galvanizing. The Contractor shall overtap so the nut will assemble freely on the coated bolt in accordance with ASTM A 563. Bolts and nuts in each galvanized assembly shall be galvanized by the same method; bolts and nuts galvanized by different methods shall not be mixed together and must be stored in distinctively separate containers and locations.

The Contractor shall lubricate galvanized nuts with a dyed lubricant of a color that contrasts with the galvanizing color and is distinctly different from dyed lubricants used for other types of galvanized nuts. All galvanized bolts and nuts shall come from the manufacturer in assemblies in watertight containers and shall not be mixed with other production lots of fastener assemblies. All high strength bolt fastener assemblies shall be stored in their original containers, in protected shelter, until placed into use. The fasteners shall be protected from contamination, with lubricant remaining intact. Bolt and nut assemblies shall remain in their original containers and only removed as necessary to be placed into use. Bolt and nut assemblies that are not used by the end of the work period shall be promptly returned to their original containers and protected storage. Should the lubricant on bolt and nut assemblies be contaminated or removed, it must be replaced only with an approved lubricant and in the manner as specified by the fastener assembly manufacturer.

542.2.3 Washers

The Contractor shall provide washers in accordance with ASTM F 436, type 1 carbon steel and / or type 3 weathering steel.

The Contractor shall use flat circular hardened washers in accordance with Table 542.2.3:1, "Circular Washer Dimensions," and Table 542.2.3:3, "Washer Tolerances."

Should the surface beneath where the head or nut will bear have a slope greater than 1:20 with respect to the plane normal to the bolt axis, the Contractor shall use square or rectangular beveled washers that taper in thickness in accordance with Table 542.2.3:2, "Square or Rectangular Beveled Washers for American Standard Beams and Channels," and Table 542.2.3:3, "Washer Tolerances." Where necessary to provide a proper fit, the Contractor shall clip washers on one (1) side no closer than $\frac{1}{8}$ of the bolt diameter from the center of the washer and only such that the hole in the outer ply of the joint is completely covered to prevent entry of moisture into the connection.

When a short-slotted hole occurs in an outer ply of a joint with ASTM F 3125 bolts, an ASTM F 436 washer or a 5/16-inch thick common plate washer shall be used as required to completely cover the hole.

When a long-slotted hole occurs in an outer ply of a joint with ASTM F 3125 bolts, an ASTM F 436 washer and a 3/8-inch thick plate, as wide or wider than the washer and long

enough to completely cover the hole shall be used.

Table 542.2.3:1
Circular Washer Dimensions

Bolt size D	Nominal outside diameter	Nominal diameter of hole	Thickness	
			Minimum	Maximum
1/2	1 1/16	17/32	0.097	0.177
5/8	1 5/16	21/32	0.122	0.177
3/4	1 15/32	13/16	0.122	0.177
7/8	1 3/4	15/16	0.136	0.177
1	2	11/16	0.136	0.177
1 1/8	2 1/4	1 1/4	0.136	0.177
1 1/4	2 1/2	1 3/8	0.136	0.177
1 3/8	2 3/4	1 1/2	0.136	0.177
1 1/2	3	1 5/8	0.136	0.177
1 3/4	3 3/8	1 7/8	0.178 ^a	0.28 ^a
2	3 3/4	2 1/8	0.178 ^a	0.28 ^a
Over 2 to 4 incl.	2D-1/2	D+1/8	0.24 ^b	0.34 ^b

Note: All dimensions in inches.

^a 3/16 inch nominal

^b 1/4 inch nominal

Table 542.2.3:2
Square or Rectangular Beveled Washers for American Standard Beams and Channels

Bolt size (in)	Minimum side dimension (in)	Mean thickness (in)	Slope or taper in thickness
1/2	1 3/4	5/16	1:6
5/8	1 3/4	5/16	1:6
3/4	1 3/4	5/16	1:6
7/8	1 3/4	5/16	1:6
1	1 3/4	5/16	1:6
1 1/8	2 1/4	5/16	1:6
1 1/4	2 1/4	5/16	1:6
1 3/8	2 1/4	5/16	1:6
1 1/2	2 1/4	5/16	1:6

Note: Hole tolerances are the same as for circular washers.

Table 542.2.3:3
Washer Tolerances

Dimension	≤1 1/2 inch nominal size, inclusive	>1 1/2 inch nominal size
	Nominal diameter of hole	-0, +1/32
Nominal outside dimensions	-1/32, +1/4	-1/32, +1/4
Flatness; maximum deviation from		

**Table 542.2.3:3
Washer Tolerances**

Dimension	≤1 1/2 inch nominal size, inclusive	>1 1/2 inch nominal size
straightedge placed on "cut" side shall not exceed	0.01 inch	0.015 inch
Burr shall not project above immediately adjacent washer face more than	0.01 inch	0.015 inch

542.2.4 Direct Tension Indicators

The Contractor shall use direct tension indicators in accordance with ASTM F 959.

The Contractor shall provide test reports for each production lot of a shipment in accordance with ASTM F 959, paragraph 15.2.

**Table 542.2.4:1
Dimensions of Direct Tension Indicators, Type F 3125**

Bolt size (in)	Outside diameter (in)		No. of protrusions (equally spaced)	Thickness (in)		Inside diameter (in)	
	Min.	Max.		Without protrusions, minimum	With protrusions, maximum	Min.	Max.
1/2	1.167	1.187	4	0.104	0.180	0.523	0.527
5/8	1.355	1.375	4	0.126	0.220	0.654	0.658
3/4	1.605	1.625	5	0.126	0.230	0.786	0.790
7/8	1.855	1.875	5	0.142	0.240	0.917	0.921
1	1.980	2.000	6	0.158	0.270	1.048	1.052
1 1/8	2.230	2.250	6	0.158	0.270	1.179	1.183
1 1/4	2.480	2.500	7	0.158	0.270	1.311	1.315
1 3/8	2.730	2.750	7	0.158	0.270	1.442	1.446
1 1/2	2.980	3.000	8	0.158	0.270	1.573	1.577

542.2.5 Testing and Test Reports

542.2.5.1 Testing of Bolts

The Contractor shall conduct proof load tests in accordance with ASTM F 606, Method 1.

The Contractor shall conduct wedge tests on full size bolts in accordance with ASTM F 606, paragraph 3.5. The Contractor shall perform tests on galvanized bolts after galvanizing.

The Contractor shall ensure that the minimum testing frequency is in accordance with ASTM F 3125. The Contractor shall measure zinc coating thickness on galvanized bolts on the wrench flats or bolt head tops.

542.2.5.2 Testing of Nuts

The Contractor shall proof load test in accordance with ASTM F 606, paragraph 4.2.

The Contractor shall ensure that the minimum testing frequency is in accordance with ASTM A 563. The Contractor shall test galvanized nuts after overtapping, galvanizing, and lubricating.

542.2.5.3 Testing of Washers

The Contractor shall test galvanized washers for hardness after galvanizing. The Contractor shall remove the coating before conducting the hardness tests.

542.2.5.4 Testing of Assemblies

The Contractor shall provide the manufacturer's or distributor's rotational capacity test results on bolt, nut, and washer assemblies. The Contractor shall use washers in the test, even if washers are not used in the assembly on the Project.

The Contractor shall test each combination of bolt production lot, nut lot, and washer lot as an assembly. Unless required by the installation procedures, the Contractor shall not include washers in the lot identification.

The Contractor shall assign a rotational capacity lot number to each lot combination tested.

The minimum testing frequency is two (2) assemblies per rotational capacity lot.

542.2.5.4.1 Procedure for Rotational Capacity Tests for Long Bolts

The Contractor shall test bolts long enough to test in a tension calibrator in accordance with the following procedures:

1. Mark the calibrator face plate with lines at vertical and at 1/3 (120°) and 2/3 (240°) of a turn, clockwise from vertical;
2. Use a calibrated torque wrench;
3. Use spacers with a hole size no larger than 1/16 inch larger than the bolt to be tested;
4. Mount the bolt calibrator on a steel frame or section such as a flange or a cross frame.
 - 4.1. Put the nut on the bolt. Measure from the end of the threaded shank to the underside of the bolt head when there are 3 to 4 full threads of the bolt between the bearing face of the nut and the bolt head;
 - 4.2. Put the bolt in the tension calibrator and install the required number of shim plates and washers needed to produce the measurement from Step 4.1 (always install one (1) washer under the nut);
 - 4.3. Snug tighten the bolt with a hand wrench to the tension listed in Table 542.2.5.4.1:1, "Snug Tight Tension;" do not exceed two (2) kips more than that value;

**Table 542.2.5.4.1:1
Snug Tight Tension**

Bolt diameter (in)	Installation tension, minimum (kip)
1/2	1
5/8	2

**Table 542.2.5.4.1:1
Snug Tight Tension**

Bolt diameter (in)	Installation tension, minimum (kip)
3/4	3
7/8	4
1	5
1 1/8	6
1 1/4	7
1 3/8	9
1 1/2	10

- 4.4. Match mark the nut to the vertical line on the bolt calibrator faceplate;
- 4.5. Using the calibrated manual torque wrench, slowly tighten the bolt to at least the tension listed in Table 542.2.5.4.1:2, "Installation Tension." Measure and record the torque and the tension generated simultaneously with that torque. Measure torque with the nut in motion;

**Table 542.2.5.4.1:2
Installation Tension**

Bolt diameter (in)	Snug tension, minimum (kip)
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1 1/8	56
1 1/4	71
1 3/8	85
1 1/2	103

- 4.6. Calculate the torque in accordance with the following equation:

$$V = \frac{T \times d}{4} \quad (1)$$

Where,

- V* is the calculated torque value
T is the measured tension in pounds
d is the bolt diameter in feet

Record the calculated value. The measured torque values must equal or be less than the calculated torque. Assemblies with measured torque values exceeding this calculated value fail the test.

- 4.7. For assemblies passing Step 4.6, further tighten the bolt to the rotation listed in Table 542.2.5.4.1:3, "Required Rotation." Measure the rotation from the vertical line to the initial match marking in Step 4.4. Record the bolt tension.

**Table 542.2.5.4.1:3
Required Rotation**

Bolt length (L) measured in step 1	Required rotation (turns)
L ≤ 4d	2/3
4d < L ≤ 8d	1
L > 8d	1 1/3

Note: d = bolt diameter.

Assemblies that fail before completing the required rotation by stripping or fracture fail the test.

Bolt tension measured at the required rotation must equal or exceed the values in Table 542.2.5.4.1:4, "Minimum Tension Requirements." Assemblies that do not meet this tension fail.

**Table 542.2.5.4.1:4
Minimum Tension Requirements**

Bolt diameter (in)	Tension, minimum (kip)
1/2	14
5/8	22
3/4	32
7/8	45
1	59
1 1/8	64
1 1/4	82
1 3/8	98
1 1/2	118

- 4.8. Loosen and remove nut and examine the threads on the nut and bolt. Assemblies showing evidence of thread shear failure, stripping, or torsion failure fail.

542.2.5.4.2 Procedure for Rotational Capacity Test for Short Bolts

The Contractor shall test bolts that are too short for a tension calibrator in accordance with these procedures:

Equipment requirements:

1. A calibrated torque wrench and a spud wrench;
2. Spacers with a hole size no larger than 1/16 inch greater than the tested bolt;
3. A steel section with a normal size hole to install bolt. Any available splice hole with plate thicknesses that will provide the number of threads under the nut required in Step 3.1 of the following procedures is acceptable.

The procedure is as follows:

- 3.1 Mark the steel section with lines at vertical and at 1/3 (120°) and 2/3 (240°) of a turn, clockwise from vertical;
- 3.2 Put the nut on the bolt. Measure the bolt length and the distance from the end of the threaded shank to the underside of the bolt head when there are three (3) to five (5) full threads of the bolt between the bearing face of the nut and the bolt head.

- 3.3. Put the bolt in the hole and install the required number of shim plates to produce the thread stick-out measured in Step 3.1. Always install one (1) hardened washer under the nut.
- 3.4. Snug using a hand wrench. Do not exceed 20% of the torque determined in Step 3.6 of this procedure.
- 3.5. Match mark the nut to the vertical line on the steel section.
- 3.6. Tighten the bolt using the torque wrench by slowly turning the nut to the rotation listed in Table 542.2.5.4.2:1, "Initial Required Rotation." Use a second wrench to prevent bolt head rotation during tightening. Record the torque required to reach this rotation. Measure torque with the nut in motion.

**Table 542.2.5.4.2:1
Initial Required Rotation**

Bolt length (L) measured in Step 3.2	Required rotation (turns)
L ≤ 4d	1/3
4d < L ≤ 8d	1/2
L > 8d	2/3

Note: d = bolt diameter.

Assemblies that exceed the torque values listed in Table 542.2.5.4.2:2, "Torque Requirements," fail.

**Table 542.2.5.4.2:2
Torque Requirements**

Bolt diameter (in)	Torque foot-pounds, maximum
1/2	150
5/8	290
3/4	500
7/8	820
1	1,230
1 1/8	1,500
1 1/4	2,140
1 3/8	2,810
1 1/2	3,690

- 3.7. For assemblies that pass Step 3.5, further tighten the bolt to the rotation required in Table 542.2.5.4.2:3, "Final Rotation Requirements." Measure the rotation from the vertical line to the initial match marking in Step 3.4.

**Table 542.2.5.4.2:3
Final Rotation Requirements**

Bolt length (L) measured in step 1	Required rotation (turns)
L ≤ 4d	2/3
4d < L ≤ 8d	1
L > 8d	1 1/3

Table 542.2.5.4.2:3
Final Rotation Requirements

Bolt length (L) measured in step 1	Required rotation (turns)
Note: d = bolt diameter.	

3.8. Loosen and remove nut and examine the threads on the nut and the bolt. Assemblies showing evidence of thread shear failure, stripping, or torsional failure fail the test.

542.2.5.5 Reporting

The Contractor shall provide notarized manufacturer and distributor CTR and MTR for mill steel used to manufacture bolts, nuts and washers. The Contractor shall indicate the steel melting and manufacture location in the MTR.

The Contractor shall show test results, including zinc coating thicknesses, in the CTR. The Contractor shall show test performance locations and test dates in the CTR.

542.2.5.5.1 Manufacturer CTR

The Contractor shall provide CTRs from the bolt, nut, and washer manufacturers that include the following:

1. Lot numbers of each item tested;
2. Rotational capacity test results, rotational capacity lot numbers, and individual lot numbers of the items tested, if performed by the manufacturer;
3. Results of all other required tests; and
4. Locations where the bolt assembly components were manufactured.

542.2.5.5.2 Distributor CTR

The Contractor shall provide CTR from the bolt, nut and washer distributors that include:

1. Documentation required in Section 542.2.5.5.1, "Manufacturer CTR;"
2. Rotational capacity test results, rotational capacity lot number, and individual lot numbers of the items tested, if performed by the distributor; and
3. A statement that the manufacturer's CTR represents the same items.

542.2.5.6 Sampling and Testing by the Department

Before installation, the Project Manager will select two (2) bolt, nut and hardened washer assemblies from each rotational capacity lot and at least three (3) direct-tension indicators with accompanying bolts, nuts and hardened washers, for each diameter and grade of fastener for testing by the State Materials Bureau.

542.2.5.7 Shipping

The Contractor shall ship bolts, nuts, and washers from each rotational capacity lot in the same container. If there is only one (1) production lot number for each size of nut, washer, and direct tension indicator, the Contractor may ship the nuts, washers, and direct tension indicators in separate containers.

The Contractor shall permanently mark each container with the rotational capacity lot

number.

542.3 CONSTRUCTION REQUIREMENTS

The Contractor shall fabricate Materials it shall connect with high-strength bolts in accordance with Section 541, "Steel Structures."

The Contractor shall blast clean steel faying surfaces in accordance with SSPC-SP 10.

The Contractor shall ensure that the bolted part surfaces adjacent to the bolt head and nut are parallel within the three (3) degrees for parallel surface rolled steel members. The Contractor shall use beveled washers on surfaces with more than a 1:20 slope for proper seating. The Contractor shall use bolted parts that fit solidly together when assembled. The Contractor shall not use gaskets or other flexible material.

The Contractor shall erect joints and splices with cylindrical erection pins and bolts in accordance with Section 541, "Steel Structures." Care shall be taken when using erection pins as to not enlarge, deform or unfair the holes. The Contractor shall use high-strength bolts instead of erection bolts if necessary. These can be left in place, provided they are not loosened and retightened.

542.3.1 Installation of Bolts

The Contractor shall ensure that bolt, nut, and washer combinations are from the same rotational capacity lot.

The Contractor shall use bolts that will extend beyond the nut at least two (2) threads, but not more than 1/2 inch.

542.3.2 Lubrication

The Contractor shall ensure that black bolts are oily to the touch when delivered and installed.

The Contractor shall clean and relubricate weathered or rusted bolts and nuts before installation. The Contractor shall retest recleaned or relubricated bolt, nut, and washer assemblies.

Before installing galvanized nuts, the Contractor shall inspect the nuts to ensure the threads are properly lubricated. If lubricant is not visible or if tensioning indicates that thread friction is too high, the Contractor shall apply an approved lubricant to the remaining threads before installation.

542.3.3 Method of Installation

The Contractor shall install bolts in accordance with Figure 542.3.3:1, "Installation Details." In general, the Contractor shall use Method 1. The Contractor shall use Method 2 and Method 3, as approved by the Department, where bolt entry, wrench clearances, or inspection procedures make Method 1 impossible.

The Contractor shall prevent the stationary element from turning.

For oversized or slotted holes, the Contractor shall place additional hardened washers between the bolted Material and the fastener.

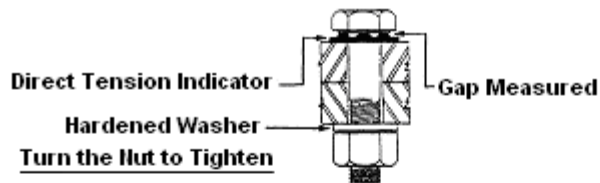
Wherever practical, the Contractor shall place the nut where it is not visible from the Traveled Way. When one end of a bolted assembly is embedded in concrete, the Contractor shall place the assembly so the nut end is in the concrete.

When tightening connections involving several bolts, the Contractor shall draw together plies of the steel by snugging the bolts before starting the tightening operations. First tighten near the center of the bolt group and work outwards alternating from side to side until the last bolts are tightened at the outside of the group. On connections involving a large number of bolts or thick Materials, the Contractor shall tighten the bolts to the point where the direct-tension indicators are partially compressed. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening before final tightening to deform the direct-tension indicators to the specified gap.

Tensioning with pneumatic or electric impact wrenches shall achieve the tension requirements within ten (10) seconds.

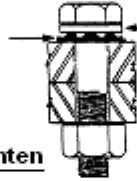
The Contractor shall ensure that the final gap between the bolt head and the direct-tension indicator is less than or equal to 0.015 in for Method 1 and less than or equal to 0.005 in for Method 2 or Method 3.

Figure 542.3.3:1
Installation Details



Method 1: Preferred Arrangement of High Strength Bolting Assembly Using Direct Tension Indicators.

Direct Tension Indicator under the bolthead and hardened washer, with the bumps facing the bolt head.



Hardened flat washer between the bolt head and the Direct Tension Indicator.

Turn the bolt head to tighten

Method 2: Alternate Arrangement of High Strength Bolting Assembly Using Direct Tension Indicators. (Turn the head).

Direct Tension Indicator under the nut with the bumps facing the nut.



Hardened flat washer between the Direct Tension Indicator and the nut.

Turn the nut to tighten

Method 3: Alternate Arrangement of High Strength Bolting Assembly Using Direct Tension Indicators. (Used when it is not possible to see the bolt head for inspection).

The Contractor shall ensure that galvanized bolt assembly direct tension indicator gap for all three (3) methods is less than or equal to 0.005 inch. The Contractor shall use Method 2 or Method 3 for galvanized bolt assemblies only after receiving Department approval.

542.3.4 Inspection

The Department will visually inspect every bolt for gaps. The Department will also check at least ten percent (10%) of the bolts, but not less than two (2) bolts in each connection, using feeler gauges as described in the direct tension indicator manufacturer's instructions and in ASTM F 959. If the inspections indicate improper installation, the Project Manager may reject the assemblies.

542.4 METHOD OF MEASUREMENT—Reserved

542.5 BASIS OF PAYMENT

The Department will pay for high strength bolts as a part of Structural Steel tonnage in accordance with Section 541, "Steel Structures."

SECTION 543: METAL RAILING

543.1 DESCRIPTION

This Work consists of providing and placing metal railing.

543.2 MATERIALS

543.2.1 Steel Railings

Unless otherwise shown in the Contract, the Contractor shall provide railing in accordance with ASTM A 36 or AASHTO M 270, Grade 50.

The Contractor shall provide square or rectangular tube steel in accordance with ASTM A 500, Grade B or ASTM A 501.

The Contractor shall provide black, seamless steel pipe in accordance with ASTM A 53. Hydrostatic testing is not required.

543.2.2 Bolts

543.2.2.1 Anchor Bolts

The Contractor shall provide anchor bolts in accordance with ASTM A 325, ASTM A 449, ASTM F 1554 or fabricate alternatively from AISI C-1144 or AISI C-1045 steel bar. The Contractor shall hot dip galvanized anchor bolts in accordance with AASHTO M 232 or mechanically galvanize in accordance with ASTM B 695, Class 50. The Contractor shall provide heavy hex nuts in accordance with ASTM A 563 Grade DH. The Contractor shall provide washers in accordance with ASTM F 436.

If the anchor bolts are fabricated from AISI C1144 or C1045 steel bar, the manufacturer shall supply certifications that demonstrate the anchor bolts meet the strength requirements of ASTM F 1554.

543.2.2.2 Connection Bolts

The Contractor shall provide connection bolts in accordance with ASTM A 307, Grade A; connection nuts in accordance with ASTM A 563, Grade A; connection washers in accordance with ASTM F 844, unless otherwise noted on the Plans or Standard Drawings. The Contractor shall ensure that bolt dimensions are in accordance with ANSI B 18.2.1, and nut dimensions are in accordance with ANSI B 18.2.2. The Contractor shall ensure washer dimensions and tolerances are in accordance with Section 542.2.3, "Washers."

543.2.3 Caulking Compound

The Contractor shall use cold-applied, single component, chemically curing silicone joint sealant for concrete pavement (non sag). Sealant shall conform to ASTM D5893, Type NS.

543.3 CONSTRUCTION REQUIREMENTS

The Contractor shall fabricate, weld, and erect railing in accordance with Section 541, "Steel Structures."

For purposes of impact testing, the Department considers steel Bridge railings and posts as main members.

The Contractor shall submit railing shop drawings and erection Plans in accordance with Section 541.3.3, "Shop and Erection Drawings."

543.3.1 Erection Tolerances

For a Bridge on a tangent, the Contractor shall ensure the railing is visually straight. In general, the Contractor shall ensure that the railing does not deviate more than 3/8 inch within 20 horizontal feet.

For a Bridge on a curve, the Contractor shall not deviate more than 13/16 inch from the curve within 20 horizontal feet.

The Contractor shall ensure the rail posts are plumb within 1/4 inch over the full height.

543.3.2 Protective Coating

When the Contract specifies the railing to be colored, the Contractor shall powder coat the railing in accordance with Section 545, "Protective Coatings of Miscellaneous Structural Steel," unless otherwise specified in the Contract.

When the Contract specifies railing to be galvanized, the Contractor shall galvanize in accordance with AASHTO M 111.

543.3.3 Cutting Rail Posts

The Contractor shall bevel cut posts to compensate for Roadway grade, crown, and superelevation.

If the Roadway grade is less than or equal to one percent (1%), the Contractor shall fabricate rail posts perpendicular to the grade line, but bevel cut crown and superelevation where necessary.

543.3.4 Caulking Rail Post Base Plates

Before placing rail posts into position on a Bridge deck, the Contractor shall apply a full circle bead of caulking compound on the deck surface around each of the anchor bolts. After erecting and coating the Bridge railing, the Contractor shall apply a bead of caulking compound around the perimeter of each rail-post base plate. The Contractor shall clean the deck surface and the surface of the rail-post anchor plates before applying the caulking compound.

543.4 METHOD OF MEASUREMENT

The Department will measure in place metal railing from end to end.

543.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Metal Railing</i>	Linear Foot

543.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Submittals; nondestructive testing; protective coatings;
2. Additional weight of heavier sections provided solely for the Contractor's convenience; and
3. All Incidentals necessary for the completion of the Work.

SECTION 544: PROTECTIVE COATING OF NEW STRUCTURAL STEEL

544.1 DESCRIPTION

This Work consists of applying liquid coating Materials to steel surfaces.

The Contractor shall refer to Section 541, "Steel Structures" for galvanized (hot-dipped)" applications. The Contractor shall refer to Section 545, "Protective Coating of Miscellaneous Structural Steel" for two (2) coat and powder coating applications. Note that Bridge railings are included in Section 545, "Protective Coating of Miscellaneous Structural Steel." The Contractor shall refer to Section 546, "Recoating Structures" for field repair of liquid coatings. The Contractor shall adhere to all requirements in Section 547, "Safety and Environmental Requirements for Painting Operations" of this Specification.

544.1.1 Terminology and Standards

The Contractor shall use terminology in accordance with the following standards:

1. Society for Protective Coatings (SSPC) Painting Manual Volume 2;
2. Surface Preparation Standards, Guides, and Specifications, Section 2 of the SSPC Painting Manual Volume 2 (SSPC-SP) American Architectural Manufacturer's Association (AAMA);
3. American Association of State Highway and Transportation Official (AASHTO);
4. American Society for Testing and Materials (ASTM); and
5. American Institute of Steel Construction (AISC).

544.2 MATERIALS

544.2.1 Coating System

The Contractor shall select a complete coating system comprised of products meeting all performance requirements as listed in Table 544.2.1:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products in each system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 544.3.4.4:1, "Required Film Thicknesses."

Inorganic Zinc-Rich Primer – Shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight.

Epoxy Intermediate Coat – Shall be a two (2) component epoxy, polyamide or polyamidoamine, including Phenalkamine coatings with minimum solids by volume of 65%.

Polyurethane Topcoat – Shall be a two (2) component aliphatic polyurethane coating with minimum solids by volume of 65%.

**Table 544.2.1:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
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**Table 544.2.1:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Slip Coefficient	ASTM A 325, Appendix A.	IOZ	Class B, Min. 0.5	
Salt Fog Resistance	ASTM B 117	P/I/T (IOZ)	(A) No Delamination Allowed (B) Rust – Max creep 4mm, Avg. creep 2mm @5000 Hrs. (C) Blister – Conversion #8 @ 4000 Hrs.	
Cyclic Weathering Resistance	ASTM D 5894	P/I/T (IOZ)	(A) No Delamination Allowed (B) Rust – Max creep 4mm, Avg. creep 2mm @5040 Hrs. (C) Blister – Conversion #9 @ 4032 Hrs.	
Adhesion Pull-Off Strength	ASTM D 4541	IOZ Alone P/I/T (IOZ)	2.4 MPa (600 psi) 2.4 MPa (600 psi)	
Freeze-Thaw Stability Pull-Off Strength	ASTM D 4541	P/I/T (IOZ)	2.4 MPa (350 psi) 4.1 MPa (600 psi) 2.4 MPa (350 psi) 4.1 MPa (600 psi)	Requires same average as adhesion pull-off strength results, with no tests measuring less than 60% of those results
Field History	NA	P/I/T (IOZ)	Five (5) Bridges with Minimum two (2) year successful field history	

P = Primer; I = Intermediate coat; T = Topcoat; IOZ = Inorganic Zinc Rich Primer

For structural components that require a galvanized (hot-dipped) coating, reference Section 541.2.5, "Structural Steel Coatings."

Primer information for the use of organic zinc for touch-up and repair is included in Section 546, "Recoating Structures."

If the Contract does not specify a color, the Contractor shall use the color Federal Standard 595A Color No. 22563 or approved equal.

544.2.2 Submittals

In addition to the submittals require per Section 106, "Control of Materials," the Contractor shall provide the following submittals to the Project Manager at least 30 Days before coating operations:

1. Product data and SDS for each product in the system;
2. Surface preparation requirements;
3. Application instructions:
 - a. Mixing and thinning directions;
 - b. Recommended spray nozzles and pressures;
 - c. Minimum / maximum drying times, including re-coat times for shop or field coatings;
 - d. Temperature requirements;
4. Letter from the manufacturer detailing the coating system components and the compatibility of those components to adjacent Materials including but not limited to:
 - a. Every product in the system (primer, intermediate, topcoat, etc.);
 - b. Any pre-applied or preexisting products (such as existing coatings);
 - c. Any post applied products (such as anti-graffiti coating);
 - d. Any modifications to the surface preparation or application instructions related to the total system performance;
5. If the color varies from the specified color, the Contractor shall submit color samples on boards at least eight (8) inches by ten (10) inches for review and approval; and
6. Documentation related to Contractor Qualifications per Section 546.2.3.1, "Contractor Qualifications."

544.2.2.1 Certification

After the Department approves the coating Material, the Contractor shall submit:

1. Notarized manufacturer's Certificates of Compliance stating that the Materials are the same as those described in the manufacturer's product data sheets; and
2. Certified test reports from an independent Laboratory performed in accordance with AASHTO R-31, showing Acceptable performance results as listed on the chart in Section 544.2.1, "Certification." The Contractor shall submit two (2) copies of each to the Department.

544.2.2.2 Product Data Sheets

The Contractor shall provide manufacturer's product data sheets with each Submittal that shows the following:

1. Mixing and thinning directions;
2. Recommended spray nozzles and pressures;
3. Minimum/maximum drying time, including re-coat times, for shop or field applied coats; and
4. Manufacturer recommended application procedures, including temperature

requirements.

544.2.2.3 Contractor Qualifications

When the Contract requires painting more than 1,500 sq. ft of steel surface, the Contractor shall demonstrate qualification by one (1) of the following two (2) methods:

Method 1

The Contractor shall obtain SSPC QP 1 certification for field painting or either SSPC-QP 3 certification or the AISC Sophisticated Paint Endorsement (SPE) for shop painting. The Contractor shall perform and document QA/QC inspections daily. QA/QC inspection documents shall be electronically submitted to the Project Manager on a weekly basis.

Method 2

The Contractor shall provide a coating Plan and provide for NACE certified inspection (Level 2 minimum). The inspection services shall include but not be limited to:

1. Surface preparation and cleanliness inspection verifying profile and appropriate surface preparation.
2. Confirm and document products match approved submittals and certification letters. Document the batch numbers of all coatings.
3. Inspection of primer coat to include dry film thickness readings. Review Contractors QA/QC reports for environmental conditions and document.
4. Observe application of stripe coat on the intermediate coat and document environmental readings during the start and stop of application. Review Contractors QA/QC reports.
5. Inspect intermediate coat to include dry film thickness readings. Review Contractor's QA/QC reports.
6. Observe start and stop of finish coat application and document environmental conditions.
7. Inspect members after transportation, prior to subsequent coating and / or Final Acceptance.
8. Final Inspection to include visual inspection for runs, sags, and foreign Material in coating. Also perform final dry film thickness inspection.
9. Electronically submit interim reports after each inspection to the Project Manager within three (3) Working Days.
10. Electronically submit comprehensive final report including photos to the Project Manager within 14 Days of completion of inspection. Final report shall include QA/QC daily inspections performed by the Contractor.
11. Add field connection points.

Any deficiencies shall be corrected and re-inspected by the NACE inspector prior to proceeding.

Provisions for demonstration of qualifications are incidental to the performance of the coating; no additional payment shall be made. NMDOT shall be granted open access to the coating operation to perform inspections and to review documentation of Contractor inspections.

544.3 CONSTRUCTION REQUIREMENTS

The Contractor shall apply coatings in conformance with SSPC – PA 1 “Shop, Field and Maintenance Painting of Steel” and with SSPC – PA Guide 13 “Guide Specification for

544.3.1 Surface Preparation for Priming

The Contractor shall remove oil, grease, and other contaminants with methods specified in SSPC-SP I Solvent Cleaning, or other Department-approved methods.

The Contractor shall blast-clean the carbon steel surfaces, in preparation for coating, in accordance with SSPC-SP 10 Near White Metal Blast Cleaning.

Prior to commencing full surface preparation activities, the Contractor shall prepare an Acceptance standard on a flat portion of the surface to be cleaned, located by the Project Manager. The Project Manager shall make the final determination as to whether prepared surfaces meet the Specification. The surfaces shall be evaluated using the SSPC-Vis 1, Visual Standard for Dry Abrasive Blast Cleaning. The Contractor shall provide the SSPC-Vis 1 manual for the Project Manager for inspection and Acceptance. The Vis 1 Guide shall become the property of the Department.

The Contractor shall select the type of abrasive. All abrasives brought to the site shall be stored in a clean and dry environment. Abrasives shall not be recycled or re-used without NMDOT approval. The Contractor shall ensure that the abrasives produce a uniform profile from one (1) mil to three (3) mils with an angular pattern as measured in accordance with SSPC-PA 17 / ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel. If surface profile requirements of the coating manufacturer differ from those specified herein, the Contractor shall comply with the coating manufacturer’s requirements. Actual replica test tapes used shall be maintained with the permanent Project inspection records. The profile shall be measured a minimum of three (3) times for every 500 feet of surface area, or as directed by the Project Manager.

The Contractor shall prepare all corners, pockets, re-entrant angles, splice plates and bolted or riveted connection plates. The Contractor shall remove fins, tears, slivers, and burred or sharp edges found during the blast cleaning operation. The Contractor shall grind and re-blast the area in accordance with SSPC-SP 10, “Near White Metal Blast Cleaning.”

Immediately prior to coating application, the Contractor shall ensure that the surface complies with the degree of cleaning specified in SSPC-SP 10, including but not limited to ensuring the absence of dust, loose residue, oil, grease, rust or other contaminants.

544.3.2 Coating Preparation

544.3.2.1 Mixing Coatings

The Contractor shall mix coatings using a power mixer. The Contractor shall not use paint shakers. The Contractor shall mix the coatings, as much as possible, in the original containers. Only complete kits shall be mixed and used.

The Contractor shall strain coatings through a 30 – 60 mesh screen, or per coating the manufacturer’s recommendations. Zinc pigmented primers shall have no clumps of zinc remaining in the coating after mixing and during application.

The Contractor shall agitate mixed primers continuously from straining through application.

544.3.2.2 Thinning Coatings

The Contractor shall not thin the coatings without the approval of the Project Manager. If it is necessary to thin the coatings, the Contractor shall thin the Material in accordance with the manufacturer's recommendations.

544.3.3 Temperature and Weather Limitations

The application of a coating system shall occur only when the air and substrate temperature is within the range indicated by the manufacturer's written instructions for both application and curing and can be expected to remain in that range.

The following conditions shall be considered but shall not supersede the manufacturer's written instructions. The Contractor shall apply the coating when the air and surface temperatures are above 40 °F and at least five (5) °F above the dew point. The Contractor shall apply the coatings when the relative humidity is 85% or lower. Coatings shall not be applied in rain, wind, snow, fog or mist. Coatings shall not be applied on frosted or ice-coated surfaces. The Contractor shall apply inorganic zinc primers when the relative humidity is 50% or higher. Manufacturer may require water misting of inorganic zinc primers for proper curing.

544.3.4 Coating Applications

The Contractor shall not apply coatings until the Project Manager approves the surface preparation. Prior to application of subsequent coats the Project Manager shall verify that surfaces are free of dust and any deleterious contaminants. The Project Manager may waive this approval.

When the Contract requires painting more than 1,500 square feet of steel surface, the Contractor shall have a coating manufacturer representative present to provide technical assistance at the start of each coating operation.

The Contractor shall apply subsequent coats within the recoat window specified by the manufacturer. If the recoat time period is exceeded, the undercoat surface shall be specially treated as recommended by the manufacturer before subsequent coats are applied. Such treatments include but are not limited to mild abrasion, solvent treatment, or use of a fog coat.

544.3.4.1—Reserved

544.3.4.2 Coating Options

The Contractor shall use one (1) of the following coating options:

1. Apply the primer, intermediate, and protective topcoat in the shop;
2. Apply the prime coat in the shop and the intermediate and protective topcoat in the field; or
3. Apply the primer and intermediate coat in the shop and the protective topcoat in the field.

544.3.4.3 Spray Equipment

The Contractor shall apply coatings with spray nozzles at pressures recommended by the coating system manufacturer.

The Contractor shall use conventional or airless spray systems to apply the coatings, following manufacturer application instructions.

544.3.4.4 Film Thickness Requirements

The Contractor shall provide coating thicknesses in accordance with Table 544.3.4.4:1, "Required Film Thicknesses." The Department will reject the coating if the DFT (dry film thickness) gauge shows less than the specified minimum thickness for any coating.

**Table 544.3.4.4:1
Required Film Thicknesses**

Coating	Dry film thickness range (mils)
Primer	2.0 – 4.0
Intermediate	4.0 – 6.0
Polyurethane Protective Topcoat	3.0 – 5.0

The Contractor shall determine the dry film thickness using magnetic film thickness gauges, SSPC PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements. The Contractor shall calibrate the gauges on blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. All dry film thickness requirements are to be measured above the peaks of the blast profile.

544.3.4.5 Primer Application

The Contractor shall prime coat all Structural Steel surfaces, except as noted in Section 544.3.4.6, "Bolted and Welded Connections."

The Contractor shall not apply primers over blasted steel that has begun to rust or bloom. The Contractor shall apply primer in a smooth, wet, continuous film.

A stripe coat of primer Material shall be applied to all edges, corners, seams, crevices, interior angles, junctions of joining members, rivets, bolt heads, nuts and threads, welds and similar irregularities. The stripe coats shall be of sufficient thickness to completely hide the surface being covered and shall be followed, as soon as practicable, by a full application of the appropriate coating to its specified thickness.

The Contractor shall apply all coatings according to the latest manufacturer's written instructions. The Contractor shall repair deficiently primed areas in accordance with the manufacturer's recommendations and as directed by the Project Manager. The Contractor shall remove dry overspray with light sanding.

The Contractor shall give steel Bridge sole plates one (1) coat of zinc rich primer. The Contractor shall mask-off strips where sole plates will be welded to beam flanges and surfaces that will be in contact with elastomeric bearing pads. After welding, the Contractor shall apply a primer touch-up to the welded areas.

544.3.4.6 Bolted and Welded Connections

The Contractor shall blast clean faying (contact) surfaces in accordance with SSPC-SP 10 Near White Metal Blast Cleaning, and leave uncoated for bolting and/or field welding.

The Contractor shall make uncoated areas slightly larger than the contact areas to ensure that the bolted connections clamp down only on the blast-cleaned Material and not on painted surfaces.

The Contractor shall mask off faying areas to protect them from rust during hauling and

storage. The Contractor shall apply a rust prohibitor to the faying surfaces or coat the faying areas with a Class B primer (slip coefficient equal to or greater than 0.50), as listed in Table 544.2.1:1, "Acceptable Product Requirements." The Department will approve the rust prohibitor or Class B primer. Before bolting, the Contractor shall remove the rust prohibitor. The Contractor shall not remove Class B primers before bolting, unless required.

Immediately before bolting and/or field welding, the Contractor shall ensure the exposed connection areas are in accordance with SSPC-SP 10 Near White Metal Blast Cleaning. The Contractor shall apply the complete coating system to these surfaces after erection. The Contractor shall mask-off connection areas to leave neat lines between the connection area coating and previously coated areas.

The Contractor shall apply the topcoats on bolted field connections after placing the deck.

544.3.4.7 Intermediate Coat Application

After cleaning and before applying the intermediate coating system, the Contractor shall mask opposite sides of the diaphragms and stiffeners over areas that the direct tension indicators will bear on. The Contractor shall not coat these areas until after erection and bolt tightening.

Before applying the intermediate coat, the Contractor shall tie coat any galvanized components using manufacturer's recommended tie coat Material. The Contractor shall apply the tie coat with a brush.

The Contractor shall not apply the intermediate coat to the following Structural Steel surfaces:

1. Faying surfaces of bolted connections (Section 544.3.4.6, "Bolted and Welded Connections");
2. The top flange top surfaces of beams, girders or diaphragms to be embedded in concrete;
3. Bearing surfaces resting on concrete Substructures or are subject to sliding and rotational movement; and
4. Bearing surfaces in contact with elastomeric bearing pads.

A stripe coat of intermediate Material shall be applied to all edges, corners, seams, crevices, interior angles, junctions of joining members, rivets, bolt heads, nuts and threads, welds and similar irregularities. The stripe coats shall be of sufficient thickness to completely hide the surface being covered and shall be followed, as soon as practicable, by a full application of the appropriate coating to its specified thickness.

544.3.4.8 Urethane Protective Topcoat Application

The Contractor shall apply the polyurethane protective topcoat only on cured intermediate coat.

544.3.5 Handling Steel

The Contractor shall protect uncoated faying surfaces to minimize corrosion during shipping and storage.

The Contractor shall store Structural Steel on pallets so it does not rest on dirt. The Contractor shall store beams and girders in an upright (as erected) position.

The Contractor shall use softeners to insulate steel from chains. The Contractor shall pad hooks and slings for hoisting steel. The Contractor shall space parts during shipment so that no rubbing occurs.

The Contractor shall use rubber rollers, soft support pads, or other protective devices on equipment support members or fasteners resting on or attached to newly coated surfaces.

544.3.6 Protection of the Work and the Public

During the coating operations, the Contractor shall protect Structures from blast cleaning operations, paint splatter, splashes and smirches with protective covering or other methods approved by the Project Manager.

When the protective devices or procedures are ineffective, the Project Manager may suspend the Work until corrections take place.

The Contractor shall remove blasting and coating debris from all on-site Work before reopening the area to traffic.

544.3.7 Field Repair of Liquid Coatings

Field repair of liquid coatings shall be performed in accordance with Section 546, "Recoating Structures" and the manufacturer's recommendations. Field repair shall be accomplished with the same coating system used for the original application with the exception that organic zinc rich primer may always be used.

The Contractor shall field repair coated areas that are rusted or damaged. The Contractor shall prepare the surface in accordance with Section 546.3.1, "Surface Preparation of Existing Bridges and Structures" or with methods approved by the Project Manager.

The Contractor shall prime large areas using spray Equipment, brush, or roller. The Contractor shall prime small areas with a brush. The Contractor shall spray or brush the topcoat. Two (2) or more coats may be necessary to build up the required film thickness. The Contractor shall apply topcoat only to areas where the topcoat is damaged. Requirements of Section 546.3, "Construction Requirements" apply to field repairs.

544.3.8 Inspection

The Contractor will be responsible for performing and documenting Quality Control (QC) inspections of all shop / field surface preparation and coating activities. When the Contract requires painting more than 1,500 square feet of steel surface, the Contractor shall reference Section 544.2.2.3, "Contractor Qualifications." When the Contract required painting less than 1,500 square feet of steel surface, the Contractor shall document all QC inspection activities, measurements and observations on the Daily Inspection report. These reports shall be submitted to the Project Manager at a minimum on a weekly basis and shall account for all Work performed.

The Contractor shall notify the Project Manager at least ten (10) Days before surface preparation and/or coating to allow adequate time to plan inspection activities.

After completing erection, the Project Manager will inspect the surfaces to be embedded in concrete. The Contractor shall repair damaged or rusted surfaces before placing decks. After placing the deck and at an agreed upon time, the Project Manager will inspect the entire steel Structure for coating system damage. The Project Manager will mark damaged areas for

repair and will re-inspect after repairs are complete.

544.3.9 Final Operations

544.3.9.1 Final Cleaning

The Contractor shall clean the steel Structure, bearings, and Bridge seat tops after completing coating activities.

544.3.9.2 Stenciling

At the completion of coating operations, the Contractor shall stencil in four (4) inch high black letters on the inside of the fascia girders at two (2) locations designated by the Project Manager:

1. The completion month and year;
2. The term "Section 544;" and
3. The coating manufacturer.

The Contractor shall make the markings with the same Material used for the urethane protective coats.

Example: "6/93-Section 544, Excel Coatings"

544.4 METHOD OF MEASUREMENT—Reserved

544.5 BASIS OF PAYMENT

The Department will pay for the coating system(s) as Incidental to the new Steel.

SECTION 545: PROTECTIVE COATING OF MISCELLANEOUS STRUCTURAL STEEL

545.1 DESCRIPTION

This Work consists of coating new steel elements including Bridge railing, pedestrian railing, drop inlet grates and frames, cattle guard grates, field coating of new steel piling, CWB access panels, gates, headgates, and flapgates, I-beam posts, safety grates, sole plates, and bearing devices, and miscellaneous steel elements.

545.1.1 Terminology and Standards

The Contractor shall use terminology in accordance with the following standards:

1. Society for Protective Coatings (SSPC) Painting Manual Volume 2;
2. Surface Preparation Standards, Guides, and Specifications, Section 2 of the SSPC Painting Manual Volume 2 (SSPC-SP);
3. American Architectural Manufacturer’s Association (AAMA);
4. American Association of State Highway and Transportation Official (AASHTO);
5. American Society for Testing and Materials (ASTM);
6. American Institute of Steel Construction (AISC); and
7. National Association of Corrosion Engineers (NACE).

545.2 MATERIALS

The Contractor shall apply the coating system specified within the Contract. If the Contract does not specify a specific coating system, the Contractor may select the coating system from Table 545.2:1, “Coating System Selection Matrix.”

**Table 545.2:1
Coating System Selection Matrix**

Specification Section	Coating System								Color Comments
	galvanize	3-Coat poly	2-Coat epoxy shop	2-Coat epoxy field	2-Coat acrylic	Powder Coat	3-Coat poly	2-Coat acrylic	if not galvanized, color (unless otherwise noted in drawings)
	541	544	545	545	545	545	546	546	
541.2.5.1	544.2.1	545.2.1	545.2.2	545.2.3	545.2.4	546.2.1	546.2.2		
Element									
structural steel	X	X					R		*
metal Bridge railing	X							R	*
metal Pedestrian railing	X							R	*
drop inlet grates & frames	X		X		X	X		R	*
cattle guard grates			X		X	X		R	safety yellow

**Table 545.2:1
Coating System Selection Matrix**

CWB Access Panels	Coating System								Color Comments
	X		X	X	X	X			R
Gates	X		X	X	X	X		R	interstate green
Headgate s & Flapgate s**			X	X	X	X		R	**
I-Beam Posts	X		X	X	X	X		R	interstate green
steel piling							X R		*
sole plates & bearing devices			X					R	*
safety grates	X		X	X	X	X		R	*
Misc. steel	X		X	X	X	X		R	*
Coating Component									
Galvanizi ng	C								
inorganic zinc primer		C	C		C				
organic zinc primer				C	C		C	C	
epoxy intermedi ate		C					C	***	
polyureth ane topcoat		C					C		
epoxy topcoat			C	C					
acrylic topcoat					C			C	
powder coating						C			

"X" denotes a coating system that is acceptable for each element. Specific coating systems noted in the Contract Documents supersede the information provided in this table.

"R" denotes the coating system that is allowable for recoating unless otherwise specified in the Contract Documents. Reference 546 "Recoating Structures" for additional information. All recoating is allowable as field applied.

"C" denotes the coating system component, reference specification section for details.

* If the Contract does not specify a color, the Contractor shall use the color Federal Standard 595A Color No. 22563 or approved equal.

** If purchased as an assembly, any corrosion inhibiting coating that is provided by the manufacturer is acceptable.

*** Intermediate or tie-coat to be provided if recommended by the manufacturer.

545.2.1 Coating System No. 1: Shop Applied 2-Coat with Epoxy Topcoat

The Contractor shall select a complete coating system comprised of products meeting all

performance requirements as listed in Table 545.2.1:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products in each system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Inorganic Zinc-Rich Primer – Shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight.

Epoxy Topcoat Coat – Shall be a two (2)-component epoxy polyamide or polyamidoamine coating, including Phenalkamine coatings with minimum solids by volume of 65%.

**Table 545.2.1:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Slip Coefficient	ASTM A 325, Appendix A.	IOZ	Class B, Min. 0.5	
Salt Fog Resistance	ASTM B 117	P/T (IOZ)	(A) No Delamination Allowed (B) Rust – Max creep 4mm, Avg. creep 2mm @5000 Hrs. (C) Blister – Conversion #8 @ 4000 Hrs.	
Cyclic Weathering Resistance	ASTM D 5894	P/T (IOZ)	(A) No Delamination Allowed (B) Rust – Max creep 4mm, Avg. creep 2mm @5040 Hrs. (C) Blister – Conversion #9 @ 4032 Hrs.	
Adhesion Pull-Off Strength	ASTM D 4541	IOZ Alone	2.4 MPa (350 psi)	
		P/T (IOZ)	2.4 MPa (350 psi)	
Freeze-Thaw Stability Pull-Off Strength	ASTM D 4541	P/T (IOZ)	2.4 MPa (350 psi)	
			4.1 MPa (600 psi)	
			2.4 MPa (350 psi)	
			4.1 MPa (600 psi)	
Field History	NA	P/T (IOZ)	Five (5) Bridges with Minimum two (2) year successful field history	

P = Primer; T = Topcoat, IOZ = Inorganic Zinc Rich Primer

Primer information for the use of organic zinc for touch-up and repair is included in Section 546, "Recoating Structures."

545.2.2 Coating System No. 2: Field Applied 2 Coat with Epoxy Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 546.2.2:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer (used to prime exposed bare steel areas only, spot prime) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight.

Epoxy Top Coat over existing finishes (applied over zinc primer and other sound existing coatings deemed suitable for over coating by the coating manufacturer's representative) shall be a two (2)-component, surface tolerant epoxy coating with minimum solids by volume of 65%.

**Table 545.2.2:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Salt Fog Resistance	ASTM B 117	P/T (OZ)	(A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5000 Hrs. (C) Blister – Conversion #7 @ 4000 Hrs.	
Cyclic Weathering Resistance	ASTM D 5894	P/T (OZ)	(A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5040 Hrs. (C) Blister – Conversion #8 @ 4032 Hrs.	
Adhesion Pull-Off Strength	ASTM D 4541	OZ Alone P/T (OZ)	4.1 MPa (600 psi) 4.1 MPa (600 psi)	
Freeze-Thaw Stability Pull-Off Strength	ASTM D 4541	P/T (OZ)	2.4 MPa (350 psi) 4.1 MPa (600 psi)	Requires same average as adhesion pull-off strength results, with no tests

**Table 545.2.2:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
			2.4 MPa (350 psi) 4.1 MPa (600 psi)	measuring less than 60% of those results
Field History	NA	P/T (OZ)	Five (5) Bridges with Minimum two (2) year successful field history	

P = Primer; T = Topcoat, OZ = Epoxy Organic Zinc Rich Primer

545.2.3 Coating System No. 3: Shop or Field Applied 2 - Coat with Acrylic Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 545.2.1:1, "Acceptable Product Requirements" above for Inorganic Zinc Rich Primer or Table 545.2.2:1, "Acceptable Product Requirements" for Organic Zinc Rich Primer and 545.2.3:1, "Acceptable Product Requirements" for Acrylic Top Coat below as applicable. It is Acceptable to use either inorganic or organic zinc rich primer for 545.2.3 Coating System 3. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 545.3.1.2.8:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer (used to prime exposed bare steel areas) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight (Table 545.2.2:1, "Acceptable Product Requirements"), or;

Inorganic Zinc-Rich Primer (used to prime exposed bare steel areas) shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight (Table 545.2.1:1, "Acceptable Product Requirements"), and;

Acrylic Topcoat (applied as overcoat over sound existing coatings deemed suitable for over coating by the coating manufacturer's representative or for repair to the finish of certain items per Section 545, "Protective Coating of Miscellaneous Structural Steel;" miscellaneous steel shall be a high performance DTM acrylic coating with minimum solids by volume of 38%. Suitable for application over zinc rich primers (Table 545.2.1:1, "Acceptable Product Requirements").

**Table 545.2.3:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Adhesion Pull-Off Strength	ASTM D 4541	HPA	> 500 lbs.	One (1) coat applied over blasted steel
Flexibility	ASTM D 522	HPA	Pass: No cracking / flaking	1/8 " conical mandrel One coat applied over blasted steel

**Table 545.2.3:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Hardness (Pencil)	ASTM D 3363	HPA	Final Cure: "F"	One (1) coat applied over blasted steel
Impact	ASTM D 2794	HPA	> 140 in. lbs.	One coat applied over blasted steel

HPA = High Performance Acrylic

545.2.4 Coating System No. 4 – Powder Coating

The Contractor shall obtain primer and topcoat from one (1) manufacturer. The Contractor shall select a coating system that meets the requirements of AAMA 2604.

545.2.5 Galvanizing or Zinc Coating

Reference Section 541.2.5.1, "Galvanizing or Zinc Coating."

545.2.6 Submittals

When the Contract requires painting more than 1,500 square feet of steel surface, the Contractor shall submit a coating Plan 30 Days prior to start of coating operations. The Project Manager shall have the option to waive the coating Plan requirement.

In addition to the submittals require per Section 106, "Control of Materials," the Contractor shall provide the following submittals to the Project Manager at least 30 Days before coating operations:

1. Product data and SDS for each product in the system;
2. Surface preparation requirements;
3. Application instructions:
 - a. Mixing and thinning directions;
 - b. Recommended spray nozzles and pressures;
 - c. Minimum / maximum drying times, including re-coat times for shop or field coatings;
 - d. Temperature requirements;
4. Letter from the manufacturer detailing the coating system components and the compatibility of those components to adjacent Materials including but not limited to:
 - a. Every product in the system (primer, intermediate, topcoat, etc.);
 - b. Any pre-applied or preexisting products (such as existing coatings);
 - c. Any post applied products (such as anti-graffiti coating);
 - d. Any modifications to the surface preparation or application instructions related to the total system performance;
5. If the color varies from the specified color, the Contractor shall submit color samples on boards at least eight (8) inches by ten (10) inches for review and approval; and
6. Documentation related to Contractor Qualifications per Section 546.2.7, "Contractor

Qualifications.”

545.2.6.1 Certification

Prior to coating application, the Contractor shall submit:

1. Notarized manufacturer's Certificates of Compliance stating that the Materials are the same as those described in the manufacturer's product data sheets; and
2. Certified test reports from an independent Laboratory performed in accordance with AASHTO R-31, showing Acceptable performance results as listed on the chart in Section 545, "Protective Coating of Miscellaneous Structural Steel."

545.2.6.2 Product Data Sheets

The Contractor shall provide manufacturer's product data sheets with each Submittal that shows the following:

1. Mixing and thinning directions;
2. Recommended spray nozzles and pressures;
3. Minimum/maximum drying time, including re-coat times, for shop or field applied coats; and
4. Manufacturer recommended application procedures, including surface preparation and temperature requirements.

545.2.7 Contractor Qualifications

When the Contract requires painting more than 1,500 sq ft of steel surface, the Contractor shall demonstrate qualification by one of the following two (2) methods:

Method 1

The Contractor shall obtain SSPC QP 1 certification for field painting or either SSPC-QP 3 certification or the AISC Sophisticated Paint Endorsement (SPE) for shop painting. The Contractor shall perform and document QA/QC inspections daily. QA/QC inspection documents shall be electronically submitted to the Project Manager on a weekly basis.

Method 2

The Contractor shall provide a coating Plan and provide for NACE certified inspection (Level 2 minimum). The inspection services shall include but not be limited to:

1. Surface preparation and cleanliness inspection verifying profile and appropriate surface preparation.
2. Confirm products match approved submittals and certification letters. Document the batch numbers of all coatings.
3. Inspection of primer coat to include dry film thickness readings. Review Contractor's QA/QC reports for environmental conditions and document.
4. Observe application of stripe coat on the intermediate coat and document environmental readings during the start up of application. Review Contractor's QA/QC reports.
5. Inspect intermediate coat to include dry film thickness readings. Review Contractor's QA/QC reports.
6. Observe start up of finish coat application and document environmental conditions.
7. Final inspection to include visual inspection for runs, sags, and foreign Material in

- coating. Also perform final dry film thickness inspection.
8. Inspect members after transportation, prior to subsequent coating and / or Final Acceptance.
 9. Electronically submit interim reports after each inspection to the Project Manager within three (3) Working Days.
 10. Electronically submit comprehensive final report including photos to the Project Manager within 14 Days of completion of inspection. Final report shall include QA/QC daily inspections performed by the Contractor.

Any deficiencies shall be corrected and reinspected by the NACE inspector prior to proceeding.

Samples of a coating Plan and QA/QC inspection documents are available on the NMDOT website.

Provisions for demonstration of qualifications are incidental to the performance of the coating, no additional payment shall be made. NMDOT shall be granted open access to the coating operation to perform inspections and to review documentation of Contractor inspections.

The Project Manager shall have the option to waive the Contractor Qualification requirement for Miscellaneous Structural Steel scope.

545.3 CONSTRUCTION REQUIREMENTS

545.3.1 Liquid Coating Systems No. 1, No. 2, and No. 3

The Contractor shall apply coatings in conformance with SSPC – PA 1 “Shop, Field and Maintenance Painting of Steel” and with SSPC – PA Guide 13 “Guide Specification for Application of Coating Systems with Zinc-Rich Primers to Steel Bridges” (aka AASHTO/NSBA Steel Bridge Collaboration S 8.1) and the manufacturer’s application instructions.

545.3.1.1 Surface Preparation

The Contractor shall remove contaminants in accordance with SSPC-SP 1, or other methods approved by the Project Manager.

Surface preparation for all steel elements include in Section 545, “Protective Coating of Miscellaneous Structural Steel” shall be in accordance with SSPC-SP10 / NACE 2 Near White Blast Cleaning: When viewed without magnification shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 95% of each unit area. Staining shall be limited to no more than five percent (5%) of each unit area, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings. Unit area shall be approximately three (3) inch x three (3) inch (nine (9) sq. in.).

Prepared surfaces shall be evaluated using the SSPC-VIS 3 Guide and Reference Photographs. The Contractor shall provide a current copy of the SSPC-VIS 3 Guide and Standard to the Project Manager. It shall become the property of the Department.

The Contractor shall maintain the steel dust free and prime within eight (8) hours after

blast cleaning. The Contractor shall re-clean rusted or contaminated surfaces at no additional cost to the Department. The Contractor shall mask areas that require field welding before coating.

The Contractor shall clean again before applying each subsequent coat.

545.3.1.2 Coating

545.3.1.2.1 Mixing the Coating

The Contractor shall mix the coating with a power mixer to a smooth and lump-free consistency, in accordance with the coating manufacturer's Specifications.

The Contractor shall mix the coating as much as possible in the original containers and continue mixing until the metallic powder or pigment is in suspension. The Contractor shall keep mixed primers continuously agitated before and during application.

545.3.1.2.2 Thinning the Coating

The Contractor shall not thin the coatings without the approval of the Project Manager. If it is necessary to thin the coatings, the Contractor shall thin the Material in accordance with the manufacturer's recommendations.

545.3.1.2.3 Temperature and Weather Limitations

The Contractor shall only apply the coatings when the ambient air temperature and surface temperature of the steel are both above 50 °F and at least five (5) °F above the dew point.

The Contractor shall not apply the coatings when there is condensation or frost on the metal surfaces.

The Contractor shall not apply the coatings when the relative humidity is higher than 85 percent.

545.3.1.2.4 Coating Applications

The Contractor shall not apply coating until the Department approves the surface preparation. The Department may waive this inspection.

A stripe coat of primer and intermediate Material shall be applied to all edges, corners, seams, crevices, interior angles, junctions of joining members, rivets, bolt heads, nuts and threads, welds and similar irregularities. The stripe coats shall be of sufficient thickness to completely hide the surface being covered and shall be followed, as soon as practicable, by a full application of the appropriate coating to its specified thickness.

The Contractor shall repair coated areas where the primer or topcoat runs, sags or cracks.

The Contractor shall not apply any coating until the previous coat has fully cured or per the manufacturer's application requirements.

The Contractor shall allow the manufacturer's minimum recommended cure time to lapse between coats. If more than 30 Days elapse between the primer application and the topcoat application, the Contractor shall contact the coating system manufacturer for surface preparation recommendations before applying subsequent coats.

The Department may Accept minor cosmetic defects in ground level miscellaneous Structural Steel components not in public view, if the defects will not affect durability.

545.3.1.2.5 Required Coating of Components

The Contractor shall apply the primer and topcoat to steel surfaces, except those that will contact elastomeric bearing pads or are subject to sliding and rotational movements.

The Contractor shall coat new steel piling from the bottoms of the pier caps to two (2) ft below the finished grade or streambed elevations.

545.3.1.2.6 Coating of Sole Plates for Concrete Bridges

The Contractor shall deliver sole plates to the Project with one (1) coat of primer applied to all surfaces except masked-off strips, where the sole plates will be welded to the shoe plates, and surfaces that will contact elastomeric bearing pads.

Before installation, the Contractor shall clean surfaces that will contact pads in accordance with SSPC-SP 6. The Contractor shall clean off all rust on sole plates prior to installing and welding.

After installing the pads and welding the sole plates to the shoe plates, the Contractor shall touch up the primer and apply topcoat to exposed surfaces.

545.3.1.2.7 Spray Equipment

The Contractor shall apply the coatings with spray nozzles at the manufacturer recommended pressures.

545.3.1.2.8 Film Thickness Requirements

The Contractor shall apply coatings in accordance with Table 545.3.1.2.8:1, "Required Film Thicknesses."

**545.3.1.2.8:1
Required Film Thicknesses**

Coating	Dry film thickness range (mils)
Primer (IOZ)	2 – 4
or	
Primer (OZ)	3 – 5
Topcoat (epoxy)	4 – 6
or	
Topcoat (acrylic)	2 – 4

545.3.1.2.9 Field Repair of Liquid Coatings

Field repair of liquid coatings shall be performed in accordance with Section 546, "Recoating Structures" and the manufacturer's recommendations. Field repair shall be accomplished with the same coating system used for the original application with the exception that organic zinc rich primer may always be used.

The Contractor shall field repair coated areas that are rusted or damaged. The Contractor shall prepare the surface in accordance with Section 546.3.1, "Surface Preparation of Existing Bridges and Structures" or with methods approved by the Project Manager.

The Contractor shall prime large areas using spray Equipment, brush, or roller. The Contractor shall prime small areas with a brush. The Contractor shall spray or brush the topcoat. Two (2) or more coats may be necessary to build up the required film thickness. The Contractor shall apply topcoat only to areas where the topcoat is damaged. Requirements of Section 546.3, "Construction Requirements" apply to field repairs.

545.3.2 Powder Coating System No. 3

545.3.2.1 Surface Preparation

The Contractor shall remove contaminants in accordance with SSPC-SP 1, or other methods approved by the Project Manager. The Contractor shall blast clean in accordance with SSPC-SP10 Near-White Metal Blast Cleaning. Additionally, for powder-coated surfaces, an iron or zinc phosphate wash shall be included to provide long-term corrosion protection.

545.3.2.2 Primer Application

The Contractor shall use a primer that is a zinc rich epoxy powder coating designed for use over ferrous metal substrates. The Contractor shall apply the zinc rich epoxy powder coat primer to a minimum of two (2) mils dry film thickness, above the peaks of any blast profile.

545.3.2.3 Topcoat Application

The Contractor shall use a topcoat that is a super durable polyester powder coating designed to provide for maximum UV exposure protection. The Contractor shall apply the polyester topcoat to a minimum of three (3) mils dry film thickness before the primer has cured or as recommended by the manufacturer.

**Table 545.3.2.3:1
Required Film Thicknesses**

Coating	Dry film thickness range (mils)
Zinc-rich epoxy primer	Min. 2 mils
Polyester topcoat	Min. 3 mils

The Contractor shall use a magnetic film thickness gage or an electronic film thickness detector to determine dry film thickness per SSPC – PA 2, "Procedure for Determining Conformance to Dry Coating Thickness Requirements."

545.3.2.4 Fixturing

The Contractor shall suspend the components by suitable metal hooks or fixtures to provide a sufficient electrical grounding path. The Contractor shall affix the components with a

minimum of direct contact area with the fixture device.

545.3.2.5 Curing

The Contractor shall place the powder-coated components in a suitable oven and cure per the manufacturer's recommended cure cycle. The Contractor shall remove the components from the oven and allow cooling. The Contractor shall visually inspect the components to ensure a smooth continuous uniform finish, free from runs, sags, pinholes or other defects.

545.3.2.6 Touch-up Painting / Field Repair of Powder Coatings

Field repair of powder coatings shall be performed in accordance with Section 546, "Recoating Structures" and the manufacturer's recommendations. The Contractor shall use Coating System No. 2 from Section 546.2, using the inorganic zinc-rich primer only where bare metal is exposed.

Surface preparation shall be done in accordance with the manufacturer's recommendations. In the absence of manufacturer recommendations, the surface shall be prepared in accordance with SSPC-3 on the minimum surface area possible to accomplish the repair.

The Contractor shall field repair coated areas that are rusted or damaged.

545.3.3 Handling Steel

The Contractor shall handle or load newly coated Structural Steel only when the coating has fully cured.

The Contractor shall store coated components on pallets or in other approved ways so that the steel does not rest on soil.

The Contractor shall protect steel coatings from binding chains with approved softeners. The Contractor shall hoist with padded hooks and slings. The Contractor shall space parts during shipment to ensure that no rubbing occurs.

545.3.4 Provisions for Inspection

The Contractor will be responsible for performing and documenting Quality Control (QC) inspections of all shop / field surface preparation and coating activities. When the Contract requires painting more than 1,500 sq. ft. of steel surface, the Contractor shall reference Section 544.2.7, "Contractor Qualifications." When the Contract required painting less than 1,500 sq. ft. of steel surface, the Contractor shall document all QC inspection activities, measurements and observations on the Daily Inspection report. These reports shall be submitted to the Project Manager at a minimum on a weekly basis and shall account for all Work performed.

After completing erection, the Project Manager will inspect the surfaces to be embedded in concrete. The Contractor shall repair damaged or rusted surfaces before placing decks. After placing the deck and at an agreed upon time, the Project Manager will inspect the entire steel Structure for coating system damage. The Project Manager will mark damaged areas for repair and will re-inspect after repairs are complete.

545.3.5 Protection of the Work and Public

During the coating operations, the Contractor shall protect the work and the public from blast cleaning operations, paint splatter, splashes and smirches with protective covering or other methods approved by the Project Manager.

When the protective devices or procedures are ineffective, the Project Manager may suspend the Work until corrections take place.

545.4 METHOD OF MEASUREMENT—Reserved

545.5 BASIS OF PAYMENT

The Department will pay for the coating system(s) as Incidental to the new Steel.

SECTION 546: RECOATING STRUCTURES

546.1 DESCRIPTION

This Work consists of surface preparation and recoating existing Structural Steel. Touch-up paint of surfaces coated per Sections 544, "Protective Coating of New Structural Steel;" 545, "Protective Coating of Miscellaneous Structural Steel;" and 546, "Recoating Structures" is included.

The Contractor shall adhere to Section 547, "Safety and Environmental Requirements for Painting Operations."

546.2 MATERIALS

Projects that require SSPC – SP 6 shall engage Section 546.2.1, "Coating System 1 – Polyurethane Topcoat," unless otherwise specified in the Contract.

Projects that require SSPC – SP 3, SSPC – SP 11, and/or SSPC 16 shall engage Section 546.2.2, "Coating System 2 – Acrylic Topcoat," unless otherwise specified in the Contract.

The Contractor shall reference Section 545.2.1, "Coating System" for additional information regarding coating systems that are allowable for specific elements.

If the Contract does not specify a color, the Contractor shall use the color Federal Standard 595A Color No. 22563 or approved equal. If another color is specified in the Contract, the Contractor shall select an approved system that is available in the specified color.

546.2.1 Coating System No. 1 – Polyurethane Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 546.2.1:1, "Acceptable Product Requirements" below. Testing shall be in accordance with AASHTO R-31. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 546.3.5:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight. Epoxy Organic Zinc-Rich Primer shall not be required when surface preparation of SSPC – SP 3 and / or SSPC – SP 11 is employed.

Epoxy Intermediate Coat or Tie-Coat over existing finishes shall be a two (2)-component epoxy, polyamide or polyanidoamine, including phenkamine coating with minimum solids by volume of 65%. Epoxy Intermediate Coat or Tie-Coat shall be required unless specifically excluded by the manufacturer in the compatibility confirmation letter that shall be submitted per Section 546.2.3, "Submittals."

Polyurethane Topcoat shall be a two (2)-component aliphatic polyurethane coating with minimum solids by volume of 65%.

**Table 546.2.1:1
Acceptable Product Requirements**

Test	Ref. No.	Product(S)	Acceptance Criteria	Comments
Salt Fog Resistance	ASTM B 117	P/I/T (OZ)	(A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5000 Hrs. (C) Blister – Conversion #7 @ 4000 Hrs.	
Cyclic Weathering Resistance	ASTM D 5894	P/I/T (OZ)	(A) No Delamination Allowed (B) Rust – Max creep 8mm, Avg. creep 4mm @5040 Hrs. (C) Blister – Conversion #8 @ 4032 Hrs.	
Adhesion Pull-Off Strength	ASTM D 4541	OZ Alone P/I/T (OZ)	4.1 MPa (600 psi) 4.1 MPa (600 psi)	
Freeze-Thaw Stability Pull-Off Strength	ASTM D 4541	P/I/T (OZ)	2.4 MPa (350 psi) 4.1 MPa (600 psi) 2.4 MPa (350 psi) 4.1 MPa (600 psi)	Requires same average as adhesion pull-off strength results, with no tests measuring less than 60% of those results
Field History	NA	P/I/T (OZ)	Five (5) Bridges with Minimum two (2) year successful field history	
P = Primer; I = Intermediate coat; T = Topcoat; OZ = Epoxy Organic Zinc Rich Primer				

546.2.2 Coating System No. 2 – Acrylic Topcoat

The Contractor shall select products meeting all performance requirements as listed in Table 546.2.1:1, "Acceptable Product Requirements" above and 546.2.2:1, "Acceptable Product Requirements" below as applicable. All products used in a system shall be from the same manufacturer. All products shall be represented on the latest version of the manufacturer's product data sheet as being suitable for use on Bridges and capable of being applied at the specified dry film thickness requirements in Table 546.3.5:1, "Required Film Thicknesses."

Epoxy Organic Zinc-Rich Primer shall achieve minimum SSPC Paint 20 Level 2 requirements for amount of zinc dust in the dry film of equal to or greater than 77% by weight (Table 546.2.1:1, "Acceptable Product Requirements"). Epoxy Organic Zinc-Rich Primer shall not be required when surface preparation of SSPC – SP 3 and / or SSPC – SP 11 are employed.

Epoxy Intermediate Coat or Tie-Coat over existing finishes shall be a two (2)-component

epoxy, polyamide or polyamidoamine, including phenkamine coating with minimum solids by volume of 65% (Table 546.2.1:1, "Acceptable Product Requirements"). Epoxy Tie-Coat shall be required unless specifically excluded by the manufacturer in the compatibility confirmation letter that shall be submitted per Section 546.2.3, "Submittals."

Acrylic Topcoat shall be a high performance DTM acrylic coating with minimum solids by volume of 38% (Table 546.2.2:1, "Acceptable Product Requirements").

**Table 546.2.2:1
Acceptable Product Requirements**

TEST	REF. NO.	PRODUCT(S)	ACCEPTANCE CRITERIA	COMMENTS
Adhesion Pull-Off Strength	ASTM D 4541	HPA	> 500 lbs.	One coat applied over blasted steel
Flexibility	ASTM D 522	HPA	Pass: No cracking / flaking	1/8 " conical mandrel One coat applied over blasted steel
Hardness (Pencil)	ASTM D 3363	HPA	Final Cure: "F"	One coat applied over blasted steel
Impact	ASTM D 2794	HPA	> 140 in. lbs.	One coat applied over blasted steel
HPA = High Performance Acrylic				

The Contractor may substitute Polyurethane topcoat for Acrylic topcoat at their discretion pending full system submittal and approval.

546.2.3 Submittals

In addition to the submittals require per Section 106, "Control of Materials," the Contractor shall provide the following submittals to the Project Manager at least 30 Days before coating operations:

1. Product data and SDS for each product in the system;
2. Surface preparation requirements;
3. Application instructions:
 - a. Mixing and thinning directions;
 - b. Recommended spray nozzles and pressures;
 - c. Minimum / maximum drying times, including re-coat times for shop or field coatings;
 - d. Temperature requirements;

4. Letter from the manufacturer detailing the coating system components and the compatibility of those components to adjacent Materials including but not limited to:
 - a. Every product in the system (primer, intermediate, topcoat, etc.);
 - b. Any pre-applied or preexisting products (such as existing coatings);
 - c. Any post applied products (such as anti-graffiti coating);
 - d. Any modifications to the surface preparation or application instructions related to the total system performance;
5. If the color varies from the specified color, the Contractor shall submit color samples on boards at least eight (8) inches by ten (10) inches for review and approval; and
6. Documentation related to Contractor Qualifications per Section 546.2.3.1, "Contractor Qualifications."

Prior to coating application, the Contractor shall submit a notarized manufacturer's Certificates of Compliance stating that the Materials are the same as those described in the manufacturer's product data sheets.

546.2.3.1 Contractor Qualifications

When the Contract requires painting more than 500 square feet of steel surface, the Contractor shall demonstrate qualification by one (1) of the following two (2) methods:

- **Method 1:** Obtain SSPC QP 1 certification for field painting or either SSPC-QP 3 certification or the AISC Sophisticated Paint Endorsement (SPE) for shop painting. The Contractor shall perform and document QA/QC inspections daily. QA/QC inspection documents shall be electronically submitted to the Project Manager on a weekly basis.
- **Method 2:** Provide a coating Plan and provide for NACE certified inspection (Level 2 minimum). The inspection services shall include but not be limited to:
 1. Surface preparation and cleanliness inspection verifying profile and appropriate surface preparation.
 2. Confirm products match approved submittals and certification letters. Document batch numbers of all coatings.
 3. Inspection of primer coat to include dry film thickness readings. Review contractor's QA/QC reports for environmental conditions and document.
 4. Observe application of stripe coat on the intermediate coat and document environmental readings during the start-up of application. Review Contractor's QA/QC reports.
 5. Inspect intermediate coat to include dry film thickness readings. Review Contractor's QA/QC reports.
 6. Observe start-up of finish coat application and document environmental conditions.
 7. Final inspection to include visual inspection for runs, sags, and foreign Material in coating. Also, perform final dry film thickness inspection.
 8. Inspect members after transportation, prior to subsequent coating and / or Final Acceptance.
 9. Electronically submit interim reports after each inspection to the Project Manager within three (3) Working Days.
 10. Electronically submit comprehensive final report including photos to the Project Manager within 14 Days of completion of inspection. Final report shall include QA/QC daily inspections performed by the Contractor.

Any deficiencies shall be corrected and re-inspected by the NACE inspector prior to proceeding.

Provisions for demonstration of qualifications are incidental to the performance of the coating; no additional payment shall be made. NMDOT shall be granted open access to the coating operation to perform inspections and to review documentation of Contractor inspections. The Project Manager shall have the option to waive the Contractor Qualification requirement.

546.3 CONSTRUCTION REQUIREMENTS

The Contractor shall apply coatings in conformance with SSPC – PA 1 “Shop, Field and Maintenance Painting of Steel” and with SSPC – PA Guide 13 “Guide Specification for Application of Coating Systems with Zinc-Rich Primers to Steel Bridges” (aka AASHTO/NSBA Steel Bridge Collaboration S 8.1), SSPC-TU 3 “Technical Update No. 3 Overcoating”, and the manufacturer’s application instructions.

546.3.1 Surface Preparation of Existing Bridges and Structures

The Contractor shall perform surface preparation in accordance with the most stringent of the following:

1. At locations where loosely adherent coatings or corrosion are NOT present: SSPC – SP 1, and
2. At locations where loosely adherent coatings are present: SSPC – SP 3, and
3. At locations where corrosion is present: SSPC – SP 11, or
4. Specific Contract document requirements, or
5. Specific guidance by the Project Manager, or
6. Manufacturer recommendations (per the application instructions as amended by the manufacturer’s letter submitted per Section 546.2.3, “Submittals,” #4d, “temperature requirements,” if applicable).

546.3.1.1 Surface Preparation Description and Evaluation

Various SSPC surface preparation standards are cited in this section. For reference, a brief summary of each is listed below. The Contractor is responsible to perform to the current versions of all requirements of the full and complete standards available directly from SSPC, The Society for Protective Coatings.

SSPC surface preparation standards brief summary reference list:

1. **SSPC-SP1 Solvent Cleaning:** Removes all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces with solvent, vapor, cleaning compound, alkali, emulsifying agent, or steam. SSPC-SP 1 is a prerequisite to all hand tool, power tool and abrasive cleaning standards. SSPC-SP1 shall be incidental.
2. **SSPC-SP3 Power Tool Cleaning:** Removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by power wire brushing, power sanding, power grinding, power tool chipping, and power tool descaling. Tightly adherent, intact Materials may remain.
3. **SSPC-SP6 Commercial Blast Cleaning:** When viewed without magnification shall be free of all visible oil, grease, dirt, dust, loose mill scale, rust, and coating, but will

permit staining from rust, mill scale, or previously applied coatings. The surface will not necessarily be uniform in color.

4. **SSPC-SP7 / NACE 4 Brush-Off Blast Cleaning:** When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.
5. **SSPC-SP10 / NACE 2 Near-White Blast Cleaning:** When viewed without magnification shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 95% of each unit area. Staining shall be limited to no more than five percent (5%) of each unit area, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings. Unit area shall be approximately three (3) inches x three (3) inches (nine (9) sq. in.). SSPC-SP10 shall only be engaged when required by the manufacturer. It shall be paid under the Bid Item for SSPC-SP6.
6. **SSPC-SP11 Power Tool Cleaning to Bare Metal:** When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than one (1) mil (25 microns).
7. **SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals:** When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. The surface shall have a minimum profile of 0.75 mil (19 microns).

Prepared surfaces shall be evaluated using the SSPC standards. The following references will be provided to the Project Manager by the Contractor for inspection and Acceptance of prepared surfaces:

1. If SP 10, SP 6, SP 14 or SP 7 are engaged: SSPC-VIS 1 Guide and Standard (includes reference photographs);
2. If SP 2, SP 3, SP 11 are engaged: SSPC-VIS 3 Guide and Standard (includes reference photographs); and
3. If SP 12 is engaged: SSPC-VIS 4 Guide and Standard (includes reference photographs).

SSPC VIS Guide and Standard shall become the property of the Department. The Contractor shall provide current version.

546.3.1.2 SSPC-SP 1 - Solvent and Pre-Cleaning

The Contractor shall clean exposed areas in accordance with SSPC-SP 1 Solvent Cleaning.

The Project Manager may approve cleaning with high pressure water and an approved, mild detergent to supplement solvent cleaning, where more effective or suitable. This method of pre-cleaning is required on all surfaces that have been exposed to chloride contamination from the use of road salts for snow and ice control.

546.3.1.3 SSPC-SP 3 Power-Tool Cleaning

The Contractor shall remove poorly adhering coatings and prepare the surface with power-tools in accordance with SSPC-SP 3, Power Tool Cleaning. At the Contractor's discretion, SSPC-SP 7 or SSPC-SP 12 WJ 3 may be employed in lieu of SSPC-SP 3.

546.3.1.4 SSPC-SP 6 – Commercial Blast Cleaning

The requirement for commercial blast cleaning shall be established by the more stringent of Contract documents or the manufacturer's recommendations.

546.3.1.5 SSPC-SP 7 – Brush-Off Wet Blast Cleaning

The requirement for brush-off wet blast cleaning shall be established by the more stringent of Contract documents or the manufacturer's recommendations. Acceptability of wet cleaning shall be determined by the Project Manager as confirmed against Project environmental constraints.

546.3.1.6 SSPC-SP 10 – Near-White Blast Cleaning

The requirement for near-white blast cleaning shall be established by the manufacturer's recommendations. SSPC-SP 10 shall be paid under the same Bid Item as SSPC-SP 6.

546.3.1.7 SSPC-SP 11 – Power-Tool Cleaning to Bare Metal

The Contractor shall clean areas that show moderate to severe corrosion in accordance with SSPC-SP 11, *Power-Tool Cleaning to Bare Metal*. Areas too large to be prepared using power tools may be cleaned per SSPC SP-6 Commercial Blast Cleaning at the Contractor's discretion.

The Project Manager will mark additional areas for cleaning in accordance with SSPC-SP 11. The Contractor shall clean at least two (2) inches beyond the damaged areas in all directions. The Contractor shall feather the exposed edges of the cleaned areas in accordance with SSPC-SP 11. The Contractor shall not leave ragged edges of intact paint. During and after power-tool cleaning, the Contractor shall maintain the degree of cleaning specified in accordance with SSPC-SP 11.

The Department will Accept these surfaces by visually comparing them to a prepared Standard on the Project. The Contractor shall prepare a Project Standard by power-tool cleaning an area designated for recoating. Before cleaning, the Contractor shall ensure that the prepared Standard is in accordance with SSPC-Vis 3, *Visual Standard for Power and Hand-Tool Cleaned Steel*, Pictorial Standard E SP 11, F SP 11, and G SP 11, and obtain Department approval. The Contractor shall prepare at least one (1) standard for each Structure. More than one (1) Standard may be necessary if the cleaned steel differs significantly from the photographic Standards. For recoating Bridges, the Contractor shall make the Standard at least one (1) ft × one (1) ft. For recoating Bridge railing or minor Structures, the Standard may be smaller. The Contractor shall protect the Project Standard from corrosion and contamination by applying a clear polyurethane coat. Upon completing the cleaning Work, the Contractor shall re-clean and coat the Standard. If the Standard becomes deteriorated or ineffective, the Contractor shall re-establish it at no additional cost to the Department.

The SSPC VIS 1 "Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning" shall be used in this same manner to prepare a Standard for surfaces that are blast cleaned per SSPC SP-7 and SP-10.

At the Contractor's discretion, SSPC-SP 7 or SSPC _ SP 12 WJ 3 may be employed in lieu of SSPC-SP 3.

546.3.1.8 SSPC-SP 12 WJ-3 – Thorough Waterjetting

The requirement for thorough waterjetting shall be established by the more stringent of Contract documents or the manufacturer's recommendations. Acceptability of waterjet cleaning shall be determined by the Project Manager as confirmed against Project environmental constraints.

546.3.1.9 SSPC SP-16 – Galvanized Surfaces

Previously galvanized surfaces shall be prepared by the Contractor in accordance with SSPC-SP16 – Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel. Brush-off blast cleaning includes SSPC-SP1 solvent cleaning or other method approved by the Project Manager to remove oil, grease, or other contaminants. The SSPC-SP1 is followed by a dry abrasive blasting using compressed air, blast nozzles, and abrasives. To avoid formation of zinc oxides that will result in potential coating failure, blast cleaning must occur when the surface temperature is a minimum of five degrees (5°) above the dew point and the surface cannot be permitted to get damp after cleaning. The Contractor shall apply coating as soon as possible after surface cleaning.

The Contractor shall apply intermediate and top coat products in accordance with manufacturer's application instructions and this Specification.

546.3.1.10 Preparing Glossy Surfaces

All previously coated glossy surfaces shall be lightly abraded / deglossed prior to re-coating.

546.3.1.11 Testing for Chloride Contamination

Prepared surfaces with exposed metal will be tested by the Contractor for chloride contamination. All test areas will be recorded for retesting purposes. A minimum of five (5) tests per 1,000 sf or fraction thereof shall be conducted prior to surface preparation. If results greater than seven (7) micrograms per cubic centimeter are detected, the surface shall be re-cleaned as specified and re-tested at the same frequency. If Acceptable results are achieved, surface preparation may begin.

546.3.1.12 Abrasives Used in Blast Cleaning Operations

When blast cleaning options are employed in lieu of SSPC SP – 3 and SP – 11 Standards (i.e. SP-7 and SP-6), the Contractor shall select the type of abrasive. All abrasives brought to the site shall be stored in a clean and dry environment. Abrasives shall not be recycled or re-used without NMDOT approval.

546.3.1.13 Limited Access Areas

A best effort with the specified methods of cleaning shall be performed in limited access areas. These methods may need to be supplemented with other Equipment such as angle nozzles, to properly clean the limited access areas. The Acceptability of the best effort cleaning in these areas is at the sole discretion of the Project Manager.

When replacing a concrete Bridge deck, the Contractor shall not clean or coat the top surfaces of top flanges of beams and girders and shear connectors.

546.3.1.14 Chemical Paint Removal

Chemical removal products and methods may be approved by the Department.

546.3.2 Coating

546.3.2.1 Mixing the Coatings

The Contractor shall mix the coatings with a power mixer in accordance with the coating manufacturer's directions until the Material is smooth and lump-free. The Contractor shall not use paint shakers.

The Contractor shall mix the Material as far as possible in its original container and continue mixing until the metallic powder or pigment is in suspension.

The Contractor shall thoroughly disperse the coating solids that may have settled to the bottom of the container. The Contractor shall strain coatings through a 30 – 60 mesh screen, or per coating manufacturer's recommendations.

The Contractor shall continuously agitate mixed coatings until application.

546.3.2.2 Thinning the Coating

The Contractor shall not thin the coatings without the approval of the Project Manager. If it is necessary to thin the coatings, the Contractor shall thin the Material in accordance with the manufacturer's recommendations.

546.3.2.3 Coating Application

The Contractor shall apply the coating system with a brush, roller, or by spraying (preferred). The Contractor shall use nozzles and pressures in accordance with the manufacturer's recommendations.

A stripe coat shall be applied to all edges, corners, seams, crevices, interior angles, junctions of joining members, rivets, bolt heads, nuts and threads, welds and similar irregularities. The stripe coats shall be of sufficient thickness to completely hide the surface being covered and shall be followed, as soon as practicable, by a full application of the appropriate coating to its specified thickness.

546.3.2.4 Temperature and Weather Limitations

546.3.2.4.1 Temperature

The Contractor shall apply the coating when the air and surface temperatures are above 50 °F and at least five (5) °F above the dew point.

The Contractor shall not apply coatings on metal surfaces with condensation or frost.

546.3.2.4.2 Humidity

The Contractor shall not apply the coatings when the relative humidity is above 85%.

546.3.3 Priming

The Contractor shall prime coat all steel surfaces prepared in accordance with SSPC SP-11. The Contractor shall apply primer the same Day as cleaning, unless otherwise authorized by the Project Manager. The Contractor shall re-clean surfaces that develop rust or are contaminated with Deleterious Material before coating, at no additional cost to the Department.

546.3.4 Intermediate and Topcoat

The Contractor shall ensure the primer is cured and dry before applying subsequent coats.

The Contractor shall not allow the manufacturer’s recommended maximum time to lapse between coats.

546.3.5 Thickness of Coatings

The Department will reject the coating if the DFT (dry film thickness) gauge shows less than the specified minimum thickness for any coating. The Contractor shall provide coating thicknesses in accordance with Table 546.3.5:1, “Required Film Thicknesses.”

**Table 546.3.5:1
Required Film Thicknesses**

Coating	Dry film thickness range (mils)
Coating System No. 1 - Polyurethane Topcoat Overcoat / Repair System (As required for Surfaces Coated per Section 544, “Protective Coating of New Structural Steel” and Certain Items per Section 545, “Protective Coating of Miscellaneous Structural Steel”)	
Primer (epoxy organic zinc)	3.0 – 5.0 mils
Intermediate (epoxy)	5.0 – 8.0 mils
Topcoat (polyurethane)	3.0 – 5.0 mils
Topcoat (polyurethane)	3.0 – 5.0 mils
Coating System No. 2 - Acrylic Topcoat Overcoat / Repair System (As Required for Designated Items per Section 545, “Protective Coating of Miscellaneous Structural Steel”)	
Primer (epoxy organic zinc)	3.0 – 5.0 mils
Topcoat (acrylic)	2.0 – 4.0 mils

The Contractor shall determine the dry film thickness using magnetic film thickness gauges, per latest version of SSPC PA-2 Procedure for Determining Conformance to Dry Coating Thickness Requirements. The Contractor shall calibrate the gauges on blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. All dry film thickness requirements are to be measures above the peaks of the blast profile.

545.3.6 Field Repair of Liquid Coatings

Field repair shall be accomplished with the same surface preparation and coating system used for the original application with the exception that organic zinc rich primer may always be used.

The Contractor shall field repair coated areas that are rusted or damaged. The Contractor shall prepare the surface in accordance with 546.3.1, “Surface Preparation of Existing Bridges and Structures” or with methods approved by the Project Manager.

The Contractor shall prime large areas using spray Equipment, brush, or roller. The Contractor shall prime small areas with a brush. The Contractor shall spray or brush the topcoat. Two (2) or more coats may be necessary to build up the required film thickness. The Contractor shall apply topcoat only to areas where the topcoat is damaged.

546.3.7 Protection of the Work and Public

During the coating operations, the Contractor shall protect the Work and the public from blast cleaning operations, paint splatter, splashes and smirches with protective covering or other methods approved by the Project Manager.

When the protective devices or procedures are ineffective, the Project Manager may suspend the Work until corrections take place.

The Contractor shall remove blasting and coating debris from all on-site Work before reopening the area to traffic.

546.3.8 Inspection

The Contractor will be responsible for performing and documenting Quality Control (QC) inspections of all shop / field surface preparation and coating activities. When the Contract requires painting more than 500 square feet of steel surface, the Contractor shall reference Section 544.2.2.3, "Contractor Qualifications." When the Contract required painting less than 500 square feet of steel surface, the Contractor shall document all QC inspection activities, measurements and observations on the Daily Inspection report. These reports shall be submitted to the Project Manager at a minimum on a weekly basis and shall account for all Work performed.

The Contractor shall notify the Project Manager at least ten (10) Days before surface preparation and/or coating to allow adequate time to plan inspection activities.

After completing erection, the Project Manager will inspect the surfaces to be embedded in concrete. The Contractor shall repair damaged or rusted surfaces before placing decks. After placing the deck and at an agreed upon time, the Project Manager will inspect the entire steel Structure for coating system damage. The Project Manager will mark damaged areas for repair and will re-inspect after repairs are complete.

546.4 METHOD OF MEASUREMENT

The Project Manager will measure cleaned areas in accordance with SSPC-SP 11 and SSPC-SP 3 before the application of the prime coat.

546.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Recoating Structures</i>	Lump Sum
<i>SP 6 Commercial Blast Cleaning</i>	Lump Sum
<i>SP 3 Power Tool Cleaning</i>	Square Foot
<i>SP 11 Power Tool Cleaning</i>	Square Foot
<i>SP 16 Brush-Off Blast Cleaning of Galvanized Steel</i>	Lump Sum

546.5.1 Work Included in Payment

The following items will be considered as included in the payment for Recoating Structures and will not be measured and paid for separately:

1. Cleaning all exposed areas of existing steel members in accordance with SSPC-SP 1;
2. When SSPC-SP 6 is performed at the Contractor's discretion in lieu of SSPC-SP 11, SSPC-SP 11 shall be used as the pay item;
3. When SSPC-SP 7 is performed at the Contractor's discretion in lieu of SSPC-SP 3, SSPC-SP 3 shall be used as the pay item;
4. SSPC-SP 11 power-tool cleaning and priming of those areas designated in the Contract to be so included in the Lump sum price;
5. SSPC-SP 3 power-tool cleaning and priming of those areas designated in the Contract to be so included in the Lump sum price;
6. When the manufacturer requires surface preparation other than SSPC-SP 6, 3, 11, or 16 and the surface preparation is not called out to be Incidental to other Bid Items, the surface preparation shall be paid through an existing pay item that is closest in effort to that required. The Project Manager shall determine which pay item shall be used;
7. Furnishing and applying the appropriate coating system to all exposed steel surfaces of the Structure;
8. Any field touch-up required to correct shipping or installation damage;
9. Final cleanup of the Structure and the immediate area; and
10. Re-caulking the perimeters of all railing post base plates per Section 543, "Metal Railing."

SECTION 547: SAFETY and ENVIRONMENTAL REQUIREMENTS for PAINTING OPERATIONS

547.1 DESCRIPTION

This Work provides for the protection of the environment and property, and the safety and health of persons during paint removal and application (painting operations).

Paint is found predominantly on Department Bridges and may or may not be lead-based. If lead-based paint exists, the Contractor will be alerted via a Notice to Contractor.

All Work detailed in this specification shall be performed in full accordance with all applicable State, Local, and Federal regulations. In matters of non-compliance, the Project Manager may call an immediate halt to all painting operations until the matter is corrected.

If a conflict arises between this specification and any of the applicable State, Local, and Federal regulations, the applicable regulation takes precedence.

547.2 MATERIALS—Reserved

547.3 SAFETY AND ENVIRONMENTAL REQUIREMENTS

547.3.1 General Safety Requirements

Below is a partial list of applicable safety and health regulations. The reference is parenthetical:

1. General health and safety provisions (29 CFR 1926.20) including training and personal protective equipment;
2. Occupational health and environmental controls (29 CFR 1910 Subpart G, and 29 CFR 1926.62 (specifically for lead));
3. Personal protective and life-saving equipment (29 CFR 1926 Subpart E and 29 CFR 1910 Subpart I);
4. Medical monitoring (29 CFR 1926.62) and safety and health plan (29 CFR 1926 Subpart D);
5. Tools, Equipment (29 CFRs 1926.300 through 302, and 29 CFRs 1910.242 through 244); and
6. Other applicable State, Local, and Federal regulations.

547.3.1.1 Safety Compliance Documentation

The required submittals to the Project Manager differ slightly when lead-based paint is present and when it is not. Details are listed below. For submittal schedules, refer to Section 547.3.2.5, "Submittals and Certification."

With exceptions, the list below presents the documents required to confirm compliance with this section.

A written copy of the Contractor's site-specific safety and health plan (HASP) that includes, among other items:

1. A written and signed statement that the HASP conforms to 29 CFR 1926.65;
2. A brief description of all painting operations;
3. A written description of the Contractor's exposure assessment plan;

4. The identity all person(s) on site and their specific role. Of primary importance are those is direct responsible charge for painting operations, job site inspections, HASP enforcement, and emergency response. All staff training must be up to date;
5. A complete schematic or Plan of the containment structure or engineering control;
6. A schematic of the temporary waste-paint storage staging area; and
7. Copies of the applicable Safety Data Sheets.

547.3.1.2 Provisions for Department Employees

The Contractor shall provide for two (2) Department employees, personal protective equipment and other tools as appropriate for inspections of painting operations. The Contractor shall include these employees in the pre-entry briefing as required by 29 CFR 1926.65.

547.3.2 General Environmental Requirements

During all painting operations, the Contractor shall adhere to the environmental regulations listed below:

1. 20 NMAC 4 - Hazardous Waste;
2. 20 NMAC 9 – Solid Waste;
3. 40 CFR 262 – Standards Applicable to Generators of Hazardous Waste;
4. 49 CFR 172 through 178 – Transportation; and
5. Other applicable State, Local, and Federal regulations.

547.3.2.1 Waste Containment

The Contractor shall utilize a containment structure appropriate for the Work location and measure its effectiveness using an industry accepted appropriate method. For industry-accepted practices, the Contractor may refer to the Steel Structures Painting Council's (SPCC) painting application (PA) guide 6 – *Guide for Containing Debris Generated During Paint Removal Operations*.

The Contractor shall contain within the Work area, all paint debris and waste Material generated during painting operations. No visible or noticeable paint or debris/waste shall escape to the surrounding air, soil, or water. The Contractor shall suspend operations immediately and adjust the procedure and/or make necessary repairs if visible paint or debris/waste escapes from the containment structure. At no cost to the Department, the Contractor shall mitigate all releases.

547.3.2.2 Waste Collection

The Contractor shall collect and prepare waste paint and surface preparation debris and all fugitive debris/waste for disposal.

The Contractor shall minimize, to the extent possible, the unnecessary generation of paint waste/debris.

The Contractor is responsible for proper packaging, labeling, marking, and placarding of the paint waste/debris (49 CFR 172). Under no circumstances shall waste other than paint waste/debris be disposed of in the packaging.

At the end of each Working Day, packaged waste shall be secured in a locked enclosure at the Project site. The contained paint waste/debris must be disposed of immediately after paint removal operations are complete, or, when warranted, immediately after the issuance of an EPA-ID number.

547.3.2.3 Disposal

The Contractor shall arrange for and execute the proper disposal of paint waste/debris. The paint waste/debris shall be disposed of at a landfill permitted to accept the particular class of waste (hazardous or non-hazardous).

Lead-based paint waste shall be considered hazardous. The Contractor shall complete the waste manifests and waste profiles and present them to the Project Manager for signature.

If, based on weight, an EPA-ID number is required, the Contractor shall apply for and reference on all disposal paperwork, the assigned EPA-ID number. Following disposal, the Contractor shall be responsible for submitting to the NMED, the Annual Hazardous Waste Fee Report.

For industry-accepted disposal practices, the Contractor may refer to the SPCC's PA guide 7 – *Guide to the Disposal of Lead-Contaminated Surface Preparation Debris*.

547.3.2.4 Air Quality and Soil Contamination

If painting operations include the removal of lead-based paint and if required by the Contract, the Contractor shall monitor air and soil for lead content before, during, and after painting operations.

Evidence of a release shall be reported immediately to the Project Manager and to the NMED. At no cost to the Department, the cause for the release shall be repaired and the waste itself shall be remediated, transported, and disposed.

547.3.2.5 Submittals and Certification

By the Pre-Construction Conference, the Contractor shall submit to the Project Manager, the safety compliance documentation listed in section 547.3.1.1. The Project Manager will maintain a copy in the Project Office and will provide written confirmation of its receipt.

Within 90 Days after painting operations, the Contractor shall submit the information listed below. The Project Manager will provide written confirmation of its receipt:

1. A signed statement that the work is complete; that all applicable rules, laws, and regulations were followed; and descriptions of all releases, or the absence thereof, and the measures taken to address them;
2. Completed, signed, and legible copies of the waste manifest(s) and waste profile(s);
3. If warranted, a copy of the submitted Annual Hazardous Waste Fee Report; and
4. Any other pertinent paperwork.

547.4 METHOD OF MEASUREMENT—Reserved

547.5 BASIS OF PAYMENT

The safety compliance documentation described in Section 547.3.1.1, "Safety Compliance Documentation" and the disposal documentation listed in Section 547.3.2.5, "Submittals and Certification" serve as the basis for payment. Payment will not be made if this documentation is incomplete or absent.

Pay Item	Pay Unit
<i>Safety and Environmental Requirements</i>	Lump Sum

547.5.1 Work Included in Payment

The following Work and items are considered as included in the lump sum payment and no separate payment shall be made:

1. All time and materials necessary to produce the pre- and post-construction compliance documentation, containment structure plans, reporting, and fees;
2. All painting operation needs including: labor, tools, equipment, materials, monitoring, testing, storage;
3. All waste collection and disposal needs including packaging, loading, transport, manifesting, tracking, disposal, NMED reporting requirements, and all associated fees; and
4. All other needs necessary to comply with these safety and environmental requirements.

SECTION 548: COATING OF CONCRETE

548.1 DESCRIPTION

This Work consists of applying Class 4, Special Surface Finish to concrete. Reference 511.3.9, "Finishing" for additional required surface treatment. This section includes Specifications for colored concrete stain/sealer, thin film liquid applied coatings (referred to as paint), and textured coating.

For Penetrating Water Repellent Treatment, see Section 532, "Penetrating Water Repellent Treatment." For Permanent Anti-Graffiti Protective Coating, see Section 531, "Permanent Anti-Graffiti Protective Coating."

548.2 MATERIALS

The following coating systems are included in this Specification:

1. Coating System 548-1: colored concrete stain/sealer;
2. Coating System 548-2: paint; and
3. Coating System 548-3: textured coating.

When the Contract require a Class 4 Special Surface Finish, the Contractor shall provide Coating System 1: colored concrete stain/sealer, unless another method is specifically required in the Contract.

For new construction with no drainage systems, Coating Systems 1, 2, and 3 require the application of waterproofing Materials on the backside of below grade walls such as retaining walls and planter boxes. Waterproofing shall be per Section 511, "Concrete Structures."

Unless noted in the Contract, the color shall be selected by the Project Manager from the Federal Standard 595C color chart for Coating Systems 1, 2, and 3.

The Contractor shall select a coating system from the Department's Approved Products List for Coating Concrete.

548.2.1 Coating System 548-1: Colored Concrete Stain/Sealer

The Contractor shall provide an acrylic polymer penetrating concrete stain. Compositions including acrylic, silicone, silane and / or siloxane are Acceptable. Solid, opaque, and semi-transparent products are Acceptable. The stain shall contain a minimum of 40.3% solids by mass and meet the requirements described in Table 548.2.1:1, "Colored Concrete Stain/Sealer Requirements."

**Table 548.2.1:1
Colored Concrete Stain/Sealer Requirements**

Test Description	Test	Criteria
Water Vapor Transmission	ASTM D1653	0.4-0.8 grains/ sq.ft. / hr
Adhesion to Concrete	ASTM D7234	500 psi

**Table 548.2.1:1
Colored Concrete Stain/Sealer Requirements**

Test Description	Test	Criteria
Wind Driven Rain Resistance	ASTM D6904 or TT-C-555B 48 hr duration	no visible leaks, no weight gain
Accelerated Weathering	ASTM D4587 - 11 cycle, 1,000 hour duration	pass

The Contractor shall apply two (2) coats. The manufacturer shall determine the composition of the two (2) coats: i.e. one (1) coat of stain and one (1) coat of sealer, or two (2) coats of stain. Both coats shall be provided by the same manufacturer.

548.2.2 Coating System 548-2: Paint

The Contractor shall provide paint products from the Master Painters Institute's Approved Product List – MPI #108. The product shall possess the following properties:

1. Does not show excessive settling in a freshly opened full container;
2. Easily re-disperses with a paddle to a smooth, homogeneous state free of curdling, slivering, caking, color separation, lumps and skins;
3. Brushes on easily;
4. Shows no running or sagging tendencies when applied to smooth vertical surfaces; and
5. Dries to a uniform finish.

The final condition of the concrete must have penetrating water repellent properties consistent with ASTM D6532; water absorption shall perform a minimum of 80% better than untreated Material. A combination of products may be required to meet this requirement (paint, sealer, penetrating water repellent, etc.). For coating system 548-2, the Contractor shall provide a letter from the manufacturer recommending the order of application of products that will meet their product requirements and water repellent capability. This letter shall confirm the compatibility of all products in the system.

548.2.3 Coating System 548-3: Textured Coating

The Contractor shall provide a textured coating product from the Master Painters Institute's Approved Product List MPI #42.

A light sand texture shall be provided unless otherwise specified in the Contract (note: textured coatings can be specified as smooth).

The final condition of the concrete must have penetrating water repellent properties consistent with ASTM D6532; water absorption shall perform a minimum of 80% better than untreated Material. A combination of products may be required to meet this requirement (textured coating, sealer, penetrating water repellent, etc.). For coating system 548-3, the Contractor shall provide a letter from the manufacturer recommending the order of application of products that will meet their product requirements and water repellent capability. This letter shall confirm the compatibility of all products in the system.

548.2.4 Submittals

The Contractor shall submit manufacturer's product data sheets, application instructions, paint certifications and an application Plan 30 Days prior to application of coatings.

The Contractor shall provide a coating Application Plan according to the manufacturer's written recommendations. The Plan shall include:

1. Proposed surface preparation;
2. Mixing and thinning directions;
3. Rate of application;
4. Recommended spray nozzles and pressures;
5. Number of necessary coats;
6. Allowable ambient air temperature range;
7. Allowable ambient surface temperature range; and
8. Safety and damage protection Plan.

If the color varies from the specified color, the Contractor shall submit color samples on boards at least eight (8) inches by ten (10) inches for review and approval.

548.3 CONSTRUCTION REQUIREMENTS

548.3.1 General

Prior to application of a Class 4, Special Surface Finish (reference Section 511.3.9.5, "Class 4, Special Surface Finish"), the Contractor shall ensure that the surface meets the requirements of a Class 2, Rubbed Surface Finish (reference Section 511.3.9.3, "Class 2, Rubbed Surface Finish").

The Class 2 Rubbed Surface Finish, including any patch Material, must be allowed 28 Days to cure prior to the application of coating systems unless otherwise recommended by the manufacturer and approved by the Department.

548.3.2 Surface Preparation

The Contractor shall prepare the surface in conformance with the manufacturer's recommendations and shall, at a minimum, include power spraying with a minimum 4000 PSI sprayer with a zero degree (0°) rotary nozzle at a six (6) inch stand-off distance. The Contractor may also find it necessary to employ detergents or abrasives. Unless otherwise directed by the manufacturer, the prepared surface shall be in conformance with SSPC-SP 13 / NACE No. 6 'Surface Preparation of Concrete.' The concrete surface must be free of contaminants, curing compounds, form release agents, efflorescence, and existing incompatible coatings, laitance, loosely adhered concrete, and dust and shall provide a sound, uniform substrate.

Alkalinity testing by the Contractor and associated follow-up action shall be required if recommended by the manufacturer.

548.3.3 Temperature and Weather Limitations

The Contractor shall apply coatings on concrete surfaces that have cured for a minimum of 28 Days and only when the atmospheric temperature is in the range from 50 degrees F to 100 degrees F, and when the relative humidity is at or below 85 percent. Coatings shall only

be applied to a surface which is at least five (5) degrees F above the dew point. The surface temperature should remain above the minimum temperature specified above until the coating is thoroughly dry. Coatings shall not be applied when weather conditions exist which might damage the Work such as windborne dust. With the approval of the Project Manager, temperature and weather limitations may be adjusted to those conditions recommended by the manufacturer.

548.3.4 Precoating Requirements

The Contractor shall allow the surface to visually dry completely before application of coatings.

All concrete surfaces shall be inspected by the Project Manager prior to application of coatings.

The Contractor shall not apply penetrating water repellent treatment to the concrete surface before coating the concrete, unless otherwise recommended by the manufacturer.

548.3.5 Coating Application

Coating shall be applied in accordance with SSPC-PA 14.

No coating shall be applied until the preceding coat has dried/cured to the extent specified by the manufacturer.

All coatings shall be applied so that the cured film is continuous and consistent.

548.3.5.1 Thinning the Coatings

The Contractor shall not thin the coating Material without Manufacturer and Department approval.

548.3.5.2 Application Equipment Requirements

Spray application Equipment shall be employed to apply the coatings unless otherwise recommended by the manufacturer. The Contractor shall employ application Equipment that meets the requirements of the manufacturer. Brushes and rollers may be used for touch-up paint and on areas less than 20 square feet.

548.3.5.3 Dry Film Thickness

The Contractor shall apply the coatings at the dry film thickness recommended by the manufacturer. Dry film thickness shall be measured by the Contractor in accordance with ASTM D6132 using an ultrasonic film thickness gage that shall be provided and retained by the Contractor. Dry film thickness readings shall be taken and recorded every 1,000 square feet or at a minimum of once per workshift.

548.3.6 Inspection and Reporting

The Contractor shall maintain daily field reports that include:

1. Weather and temperature data;
2. Surface preparation observations including photographs;
3. Product tracking information including lot and batch numbers of the products applied;

4. Description of Equipment used and names of applicators; and
5. Records of dry film thickness (reference Section 548.3.5.3, "Dry Film Thickness").

The Contractor shall submit the inspection reports to the Project Manager on a weekly basis.

548.3.7 Project Test Area

For areas greater than 500 square feet, a Project test area shall be prepared and tested by the Contractor. The test area can be either on the Structure itself or on a sample that is representative of the substrate to be coated. The test panel shall be no smaller than three (3) square feet in size. The test panel shall be of the same Material and application process as the final product.

Following cure, adhesion testing shall be performed by the Contractor on the test panel in accordance with ASTM D7234. The location of the disbondment for each of the three (3) pulls shall be within the concrete substrate (i.e. cohesive failure of the concrete). Testing shall be observed by the Project Manager. Results of the test shall be submitted in writing to the Project Manager.

548.4 METHOD OF MEASUREMENT

Coating of the Concrete surfaces will be measured by the square foot.

548.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Coating of Concrete – Stain</i>	Square Foot
<i>Coating of Concrete – Paint</i>	Square Foot
<i>Coating of Concrete – Textured Coating</i>	Square Foot

548.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Preparation of the concrete surfaces to be painted;
2. Protection of pedestrian, vehicular or other traffic near or under the Work from paint spatter and disfigurement; and
3. Inspection and testing as required by this Specification and the Contract.

SECTION 550: TREATED TIMBER

550.1 DESCRIPTION

This Work consists of constructing timber Structures and the timber portions of composite Structures.

550.2 MATERIALS

550.2.1 Sawn Lumber and Timber

The Contractor shall provide sawn lumber and timber in accordance with AASHTO M 168, and the National Forest Products Association's *National Design Specification for Wood Construction*.

The Contractor shall meet grading rules and design values in accordance with *Supplement to the National Design Specifications for Wood Construction*.

550.2.2 Preservatives and Treatment Methods

The Contractor shall treat timber with preservatives in accordance with AASHTO M 133 and AWPA U1, Commodity Section A: Sawn Products; or use pentachlorophenol, Type C preservative treatment in accordance with AWPA P8 and P9.

550.2.3 Fasteners

The Contractor shall provide bolts, nuts, and washers in accordance with ASTM A 307.

The Contractor shall provide bolts that have standard, square or hex heads, and coarse threads with Class 2 tolerances in accordance with ANSI's *Standard Specifications for Bolted Connections*.

The Contractor shall provide washers that bear on timber surfaces in accordance with Table 550.2.3:1, "Washer Dimensions."

**Table 550.2.3:1
Washer Dimensions**

Bolt diameter	Hole diameter	Washer diameter	Washer thickness
1/2	9/16	1 3/8	3/32
3/4	13/16	2	5/32
7/8	15/16	2 1/4	11/64

The Contractor shall provide shear plates and split ring connectors in accordance with the Contract. The Department will not accept connector plates with punched-through spikes or nailer plates.

The Contractor shall provide shear plates, split ring connectors, and accompanying washers made of pressed steel or malleable iron in accordance with AITC's *Timber Construction Manual*.

The Contractor shall use nails cut from round wire of standard form. The Contractor shall use cut or wire spikes.

The Contractor shall use galvanized metal fasteners in accordance with AASHTO M 232.

The Contractor shall tap galvanized nuts oversize after galvanizing in accordance with ASTM A325 and ASTM A 563.

The Contractor shall provide steel plates in accordance with ASTM A36; galvanize in accordance with AASHTO M 232 or M 111.

550.2.4 Timber and Lumber Certification

The Contractor shall provide timber and lumber certified by an American Lumber Standards Committee certified agency.

550.2.5 Preservative Treatment Certification

The Contractor shall provide a certificate from the treatment facility or an independent inspection agency containing the following:

1. Preservative type and composition;
2. Quantity retained in pounds per cubic foot (ASSAY Method);
3. Confirmation that specification requirements were met; and
4. Copies of inspection reports.

550.3 CONSTRUCTION REQUIREMENTS

550.3.1 Working Drawings and Written Procedures

The Contractor shall submit three (3) sets of Working Drawings and erection drawings to the Department. The Department will return one (1) set with notations within 14 Days.

The Contractor shall provide up to eight (8) sets, as required, of corrected Working Drawings for final approval. The Contractor shall allow seven (7) Days for review of re-submitted Working Drawings.

The Contractor shall not begin fabrication before receiving written approval.

The Contractor shall ensure the Working Drawings contain a minimum of the following:

1. Complete details of the Structure timber components, including the following:
 - 1.1. Dimensions;
 - 1.2. Details;
 - 1.3. Cut, bevel, and notch locations; and
 - 1.4. Hole sizes.
2. Hardware details and parts lists for items such as connector plates, shear plates, split-ring connectors, lag screws, bolts, nuts and washers, including protective coating requirements;
3. Timber grade and species;
4. Preservative treatment (type, composition and percent retention);
5. An erection diagram showing piece marks, locations, orientations and attachment methods for Structure components or pieces; and
6. Special instructions required regarding Structure fabrication or erection.

550.3.2 Fabrication

The Contractor shall cut and frame lumber and timber so that the joints have an even bearing over the entire contact surfaces.

The Contractor shall tag prefabricated members with erection marks for identification and reference them in the erection drawings.

Unless otherwise specified, the Contractor shall fabricate as far ahead of treatment as possible.

550.3.2.1 Bolt Holes

Unless otherwise specified in the Contract, the Contractor shall bore holes perpendicular to the faces of the members they penetrate.

The Contractor shall bore connection holes for one (1) or two (2) bolts at the same diameter as the finished bolt, except bolt holes which are part of a shear plate or split-ring assembly.

The Contractor shall bore holes 1/16 inch larger than the bolt diameter for bolted connections using more than two (2) bolts, and for bolt holes which are part of a shear plate or split-ring assembly.

The Contractor shall drill holes in connector plates 1/16 inch larger than the bolt diameter.

550.3.2.2 Holes for Lag Screws

For lag screws, the Contractor shall bore holes with a bit no larger than the minor diameter of the lag screw thread.

To prevent splitting or stripping the threads, the Contractor shall bore shank holes in the side of the joint containing the thread to the same diameter and to the same depth as the shank. The Contractor shall ensure that holes for the shank in connected parts (wood or metal) are from 1/32 inch to 1/16 inch greater than the diameter of the shank.

The Contractor shall make the hole depths approximately one (1) inch less than the length under the head.

550.3.2.3 Recesses and Countersinking

The Contractor shall countersink when the Contract requires a smooth or flush surface. The Contractor shall treat recesses in treated timber, formed for shear plates, split-ring connectors or countersinking, in accordance with Section 550.3.3, "Preservative Treatment."

550.3.2.4 Stringers

The Contractor shall size stringers at bearings and place so that knots near edges are in the top portions of the stringers.

The Contractor may construct outside stringers butt joints with the ends dapped or cut on a taper. Unless otherwise specified in the Contract, the Contractor shall overlap interior stringers at each end to take the bearing over the full floor beam or cap width.

550.3.2.5 Cross Bridging

The Contractor shall toenail wood cross bridging between stringers with at least two (2)

nails in each end. The Contractor shall ensure the cross bridging members have full bearing at each end against the stringer sides. The Contractor shall use metal cross bridging members in accordance with the Contract or as approved by the Department.

550.3.2.6 Trusses

The Contractor shall ensure the following:

1. Completed trusses show no line irregularities;
2. Chords are straight and true from end to end in horizontal projection; and
3. Chords show a smooth curve through panel points in vertical projection.

The Department will reject pieces with uneven or rough cuts at the bearing points.

550.3.2.7 Bolts and Washers

The Contractor shall install washers under bolt heads and nuts unless using a steel plate or strap in conjunction with shear plates. If necessary, the Contractor shall use washers to extend the bolt length to prevent metal connection plates from bearing on the threaded portion of the bolt.

550.3.2.8 Nailing

Unless otherwise specified, the Contractor shall drive nails and spikes perpendicular to the surface of the timber with just enough force to set the heads flush with the surface of the wood. The Department may reject surfaces with deep hammer marks, considered evidence of poor workmanship.

550.3.3 Preservative Treatment

The Contractor shall apply preservative treatment in accordance with AWP A M4.

550.3.3.1 Marking

The Contractor shall ensure that each piece of treated timber has a legible brand, mark, or tag indicating the treatment facility name and the specification symbol or specification requirements identifying the treatment used. The Contractor shall place the brands or marks so that they are not visible after the Structure is erected.

550.3.3.2 Inspection at the Treatment Plant

The Contractor is responsible for inspection of Materials and preservative treatment.

The Contractor shall ensure that inspections are conducted in accordance with AASHTO M 133 and AWP A Standards. Third Party Inspection agencies must be ALSC approved.

The Department may conduct surveillance inspections at any time.

550.3.3.3 Inspection at the Job Site

The Department may retest the Materials after delivery to the Project.

The Department will accept timber within five percent (5%) of specified moisture content and preservative retention.

550.3.4 Handling

The Contractor shall handle treated timber with web slings. The Contractor shall not use devices that mar wood surfaces, such as cant hooks, peaveys, and pikes.

If using metal bands to bundle members, the Contractor shall provide corner protectors to prevent damage to the treated timber.

550.3.5 Storage of Material

The Contractor shall store lumber and timber on the Project in orderly stacks. The Contractor shall stack Material on supports at least 12 inches above the ground surface. The Contractor shall keep the ground in the vicinity of the timber cleared of weeds and rubbish. The Contractor shall not allow water to collect under or near the stored timber.

If required by the Project Manager, the Contractor shall provide protection from the weather with a covering.

550.3.6 Erection

The Contractor shall treat cuts, abrasions, and recesses that occur after treatment with two (2) liberal applications of a compatible preservative in accordance with AWPA M4.

The Contractor shall treat holes bored after treatment by filling the holes with the preservative used for field treatment. The Contractor shall use preservative treated plugs to plug holes not permanently filled with bolts or screws.

The Contractor shall tighten bolts securely, but not enough to crush the wood beneath the plates or washers. The Department will reject members that will not assemble after application of reasonable amounts of force.

550.4 METHOD OF MEASUREMENT

550.4.1 Treated Timber

The Department will use standard nominal dimensions and actual member lengths, in accordance with the Contract or approved modifications, to measure treated timber.

550.4.2 Metal Components

The Department will pay for metal components, exclusive of nails and spikes, in accordance with Section 541, "Steel Structures."

550.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Treated Timber</i>	Thousand Board Feet

550.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for treated timber and will not be measured or paid for separately:

1. Inspection costs;

2. Coating of timber Structures; and
3. Nails and spikes.

SECTION 560: ELASTOMERIC BEARING PADS

560.1 DESCRIPTION

This Work consists of providing, assembling, and installing elastomeric Bridge bearing pads.

560.2 MATERIALS

560.2.1 General

The Contractor shall provide bearing pad Material and testing in accordance with the Contract and AASHTO's *LRFD Bridge Construction Specification*, Section 18. The Contractor shall provide plain or laminated bearing pads reinforced with steel or fabric laminates.

560.2.2 Elastomer

The elastomer compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene). All material shall be new with no reclaimed material incorporated in the finished bearing.

560.2.3 Steel Laminates

The Contractor shall provide steel laminates to the dimensions shown in the Contract documents and in accordance with ASTM A36 or ASTM A1011, Grade 36. Steel laminates shall be no less than 1/8 inch thick.

560.2.4 Certification

The Contractor shall furnish certified Laboratory test results on the elastomer properties of compound for both plain and laminated bearings. The required tests are per AASHTO M 251-06 Table 1. For Bridges north of I-40 and including I-40, the elastomer compound shall be Grade 3. For Bridges south of I-40, the elastomer compound shall be Grade 2. Test shall be done on an annual basis or when the material Supplier changes. The Contractor shall provide copies of certified mill test reports for laminated bearing steel and any required steel components.

560.2.5 Marking

Using indelible ink or paint that will remain intact after pad deformation, the Contractor shall mark each laminated bearing pad on a face that is visible after Bridge erection, with the following information:

1. Order number;
2. Lot number;
3. Bearing identification number;
4. Elastomer type; and
5. Grade number.

560.2.6 Acceptance Criteria

The following tests shall be performed on the actual bearing pads. One (1) bearing pad per lot shall be tested.

The bearing pad shall be tested per AASHTO M 251-06 Section 8.8.2. The average compressive load shall be 2,250 psi for laminated bearing pads and 1500 psi for plain bearing pads.

The bearing pad shall be tested per AASHTO M 251-06 Section 9.1. Where the bearing strain exceeds ten percent (10%), the lot shall be rejected. If the bearing pad design loads are not shown on the Contract Drawings, the test will not be required.

Testing is to be performed by the manufacturer Laboratory with the certified test results submitted to NMDOT.

560.2.7 Submittals

Working Drawings shall be submitted to the Project Manager 14 Days prior to fabrication. Any resubmittal will require an additional seven (7) Days for review.

The Contractor shall not proceed with fabrication until Working Drawings are approved.

560.2.8 Fabrication

The Contractor shall cast bearing pads with steel laminates as a unit in a mold, bonded and vulcanized under heat and pressure. The Contractor shall provide molds with a standard mold finish. The Contractor shall sandblast internal steel laminates to remove surface coating rust and mill scale before bonding. The Contractor shall provide internal steel laminates free of sharp edges and burrs, with a minimum edge cover of 1/8 inch.

The Contractor shall manufacture as a single unit bearing pads designed to act as a single unit with a given shape. The Contractor may provide molded or extruded plain bearing pads or fabric-reinforced bearings pads vulcanized in large sheets, and cut to size. The Contractor shall cut without heating the Materials, and to produce a smooth finish in accordance with ANSI 250, with no fabric separation from the elastomer.

The Contractor shall provide single ply fabric reinforcement at the top and bottom of the reinforced bearings and double ply for internal reinforcement layers. The Contractor shall provide fabric free of folds and ripples, and parallel to the top and bottom surfaces.

The Contractor shall provide flash tolerances, finishes, and appearances are in accordance with the current *Rubber Handbook*, published by the Rubber Manufacturer's Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings.

560.2.9 Tolerances

The Contractor shall build plain and laminated bearing pads in accordance with Table 560.2.9:1, "Bearing Pad Tolerances."

**Table 560.2.9:1
Bearing Pad Tolerances**

Parameter description	Tolerance requirements
Overall Vertical thickness	
1 1/4 inch or less	0 inch to +1/8 inch
Over 1 1/4 inch	0 inch to +1/4 inch

**Table 560.2.9:1
Bearing Pad Tolerances**

Parameter description	Tolerance requirements
Overall horizontal dimensions	
36 inch and less	0 inch to +1/4 inch
Over 36 inch	0 inch to +1/2 inch
Individual layer thickness ^a	± 20% of design value but no more than ± 1/8 inch
Variations from a plane parallel to the theoretical surface ^b	
Top ^c	0.005 radians
Sides	0.02 radians
Position of exposed connection members	1/8 inch
Embedded steel plates edge cover or connection members	0 in to +1/8 inch
Hole, slot, or insert sizes	+ 1/8 inch
Hole, slot, or insert positions	1/8 inch

^aElastomer-laminated bearing pads only.

^bAs determined by measurements at the bearing edges.

^cSlope relative to the bottom.

560.3 CONSTRUCTION REQUIREMENTS

560.3.1 General

The Contractor shall ensure bearing pads in the completed Structure exhibit a compressive strain of no more than ten percent (10%).

The Contractor shall place bearing pads on level surfaces. The Contractor shall correct misalignments in the support to form a level surface.

The Contractor shall not weld steel girders or base plates to the bearing pad sole plates unless there is more than 1 1/2 inch of steel between the weld and the elastomer. The Contractor shall not expose the elastomer or elastomer bond to temperatures greater than 400 °F.

560.4 METHOD OF MEASUREMENT—Reserved

560.5 BASIS OF PAYMENT

The furnishing and installing of elastomeric bearing pads will be considered Incidental to the completion of the Work and no measurement or direct payment will be made therefore.

SECTION 561: ELASTOMERIC COMPRESSION JOINT SEALS

561.1 DESCRIPTION

This Work consists of providing and placing elastomeric compression joint seals for Bridge decks.

561.2 MATERIALS

561.2.1 General

The Contractor shall provide joint seals that prevent debris and water intrusion through the joint system. The Contractor shall provide preformed open cell seals, manufactured with elastomeric polychloroprene Material in accordance with ASTM D2628. The Contractor shall mark the top surface of joint seals.

561.2.2 Dimensional Tolerance

The Contractor shall provide seals in accordance with the Contract and manufacturer's tolerances.

561.2.3 Splicing

The Contractor shall provide seals in one (1) continuous strip for each joint.

561.2.4 Lubricant Adhesive

The Contractor shall provide lubricant adhesives in accordance with the manufacturer's recommendations.

561.3 CONSTRUCTION REQUIREMENTS

561.3.1 Preparing Joint Recesses

The Contractor shall install joint seals in prefabricated steel recesses or in recesses saw cut in the concrete. For saw cut recesses, the Contractor shall cut the joints narrower than required for the preformed seal Material. Before installing compression seals, the Contractor shall saw cut a groove to receive the seal Material along the top of the joint.

The Contractor shall simultaneously cut both sides of a groove. The Contractor shall control alignment with a rigid guide. The Department will specify the groove width based on the temperature and age of the concrete. The Contractor shall bevel saw cut lips to prevent subsequent spalling. The Contractor shall repair spalls, cracks, and protrusions in the joint surface before installing seals.

The Contractor shall set prefabricated steel recesses before placing the deck slab.

The Contractor shall ensure joint surfaces are free of paint, oil, scale, rust, and dust before applying the lubricant adhesive.

561.3.1.1 Oversized Joint Openings

The Contractor may use larger seals for oversized joint openings, at no additional cost to the Department.

561.3.2 Installation

The Contractor shall apply the lubricant adhesive to both joint faces before installing the seal. The Contractor shall compress the seal to the thickness required in the Contract, or as specified by the Project Manager for the rated opening and temperature conditions. The Department will not allow loose fits or open points between the seal and the deck concrete or metal armoring.

561.3.3 Replacing Joint Seals in Existing Decks

If replacing seals in existing Bridge decks, the Contractor shall completely remove the old seals and clean the side surfaces of the openings of all dirt, rust, and any other Deleterious Material. If required, the Contractor shall modify existing joint components or deck slab openings before installing the replacement seals.

561.3.4 Acceptance

After installation, the Contractor shall test joint seals for leakage by water flooding the joint. The Contractor shall perform testing in the presence of the Project Manager. The Contractor shall ensure the top edges of the seal are in continuous contact with the sides of the joint opening over the entire range of joint movement, or the Department may reject the seal.

561.4 METHOD OF MEASUREMENT

Elastomeric compression joint seal replacement will be measured by the linear foot.

561.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Elastomeric Compression Joint Seal</i>	Linear Foot

561.5.1 Work Included In Payment

The following Work and items will be considered as included in the payment for Elastomeric compression joint seals and will not be measured or paid for separately:

1. Leak Testing including water for leak test.

SECTION 562: BRIDGE JOINT STRIP SEALS

562.1 DESCRIPTION

This Work consists of providing, assembling, and installing Bridge joint strip seal assemblies per the Standard Drawings for Bridge Joint Strip Seals.

562.2 MATERIALS

562.2.1 General

The Contractor shall provide Bridge joint strip seals of elastomeric Material and metal components to allow expansion and contraction of the Bridge Superstructure and to seal the deck surface.

The Contractor shall anchor Bridge joint strip seal assemblies either directly in PCC with Type A anchorage or in elastomeric concrete headers or end dams with Type B anchorage. Unless noted on the Plans, Type A anchorage should be used.

562.2.2 Elastomer

The Contractor shall provide 100% virgin polychloroprene (neoprene) elastomeric sealing element in accordance with Table 562.2.2:1, "Elastomer Physical Property Requirements."

**Table 562.2.2:1
Elastomer Physical Property Requirements**

Property	ASTM test	Requirement
Tensile strength, minimum	D 412	2,000 psi
Elongation at break, minimum	D 412	250%
Hardness, durometer, neoprene	D 2240	60 ± 5
Compression set, maximum ^a	D 395	40%
Brittleness @ -40 °F	D 746	Not brittle
Property deterioration ^b	D 573	
Tensile strength loss, maximum		20%
Elongation loss, maximum		20%
Hardness point change, Type A ^c	D 2240	0 to ±15
Ozone resistance ^d	D 1149	No cracks
Oil swell ^e	D 471	
Weight increase, maximum		+45%
Resistance to salt ^f	D 471	
Variation of volume		-5% to +10%

^aAfter 70 h at 212 °F using Method B, modified.

^bAfter 70 h at 212 °F.

^cDurometer A.

^dAt 20% elongation and 300 pphm in air at 104 °F.

^eUsing ASTM Oil #3, after 70 h at 212 °F.

^fAfter 70 h at 104 °F in calcium chloride solution.

562.2.3 Metal Components

The Contractor shall provide steel retaining bars in accordance with ASTM A 588. The Contractor shall provide anchoring Materials in accordance with AASHTO M 270, (grade 36) for Structural Steel and AASHTO M 31 (grade 40) for reinforcing steel.

562.2.4 Elastomeric Concrete

The Contractor shall provide elastomeric concrete composed of an elastomeric binder and precision blended aggregates, specifically formulated for use as an energy absorbing header Material for Bridge deck expansion joints. The Contractor shall select Material from the Department's Approved Products List. The Contractor shall provide a manufacturer's Materials certification.

562.3 CONSTRUCTION REQUIREMENTS

562.3.1 Working Drawings and Submittals

The Contractor shall submit three (3) sets of complete Working Drawings to the Project Manager for preliminary review; include two (2) copies of the product literature for elastomeric concrete and joint seals, containing complete Materials data and installation instructions. 21 Days shall be allotted for preliminary review. The Contractor shall include the following information:

1. Detailed dimensions and sizes of component parts of the joint;
2. Details of miscellaneous parts;
3. Field splice details and locations;
4. Material Specifications;
5. Weld symbols; and
6. Welding electrode Specifications.

Upon receipt of the reviewed Working Drawings, the Contractor shall return one (1) set to the manufacturer or Supplier with notations. After making the required corrections, the Contractor shall submit eight (8) sets of final Working Drawings to the Department. The Contractor shall not perform Work and shall not change the Working Drawing before obtaining Department approval. Seven (7) additional Days shall be allotted for final review. The Contractor shall not perform Work prior to obtaining Department approval. The Contractor shall not modify the approved Working Drawings without Department approval.

562.3.2 Fabrication of Steel Components

The Contractor shall fabricate steel components in accordance with Section 541, "Steel Structures." The Contractor shall stamp manufacturer's name and model number at a visible location on each end of the steel extrusion.

562.3.2.1 Protective Coating

Unless otherwise specified in the Contract, the Contractor shall galvanize the surfaces of steel components in accordance with Section 541.2.6.1, "Galvanizing or Zinc Coating."

562.3.3 Manufacturer's Technical Support Representative

The Contractor shall ensure an elastomeric concrete manufacturer's technical support representative is at the site during initial installation to:

1. Advise and ensure adherence to the correct installation method;
2. Train assigned personnel in the correct methods of installation; and
3. Certify to the Project Manager that the Contractor installed the Material in accordance with the manufacturer's instructions.

Both the representative and the Contractor shall sign and date written certifications for the Project Manager. If the Contractor can show proof of satisfactory past experience installing at least ten (10) joints or 300 ft of joints using elastomeric concrete, the Project Manager may waive this requirement.

562.3.4 Temperature and Weather Limitations

The Contractor shall not place elastomeric concrete when the air or Material temperatures are below 45 °F. The Contractor shall not place elastomeric concrete during rain or snow.

562.3.4.1 Placement Temperatures

The Contractor shall preheat the ingredients of the elastomeric concrete in accordance with the manufacturer's instructions and maintain the preheat temperatures within the specified tolerances.

562.3.5 Surface Preparation

Immediately before placing the elastomeric concrete, the Contractor shall sandblast the surfaces of steel, concrete, and asphalt that will contact elastomeric concrete. The Contractor shall completely remove dirt, rust, grease, oil, and other Deleterious Material. After blasting, the Contractor shall remove loose dirt, sand, and debris by vacuuming or blowing with dry, oil-free compressed air. The Contractor shall ensure surfaces are completely dry before placing the elastomeric concrete.

562.3.5.1 Priming

Before placing elastomeric concrete, the Contractor shall prime the steel, concrete, and asphalt surfaces that will contact elastomeric concrete Material in accordance with the elastomeric concrete manufacturer's recommendations.

562.3.6 Placement of the Steel Extrusions

The Contractor shall place steel extrusions ¼ inch +/- 1/16 inch below and parallel to the final deck elevations. The Contractor shall remove and replace joints with extrusions that protrude above final deck elevations at no additional cost to the Department. Unless otherwise specified in the Contract, the Contractor shall install block-outs that have at least a 1/2 inch clearance between the steel extrusions and the block-out bottoms if using elastomeric headers.

The Contractor may field splice steel retaining bars by welding at the crown point of the Roadway and at approximately 20 foot intervals in the remaining length of the seal. The Department will not allow any other field splicing with the exception of phase line or traffic control line. Field welding certification will not be required, unless specified in the Contract Documents.

562.3.7 Mixing and Placing of the Elastomeric Concrete

The Contractor shall install elastomeric concrete headers in accordance with the manufacturer's instructions. If there is a conflict between this specification and the manufacturer's printed instructions, the Contractor shall use the more stringent requirements.

During mixing and placement operations, the Contractor shall not spill or spread elastomeric concrete on deck surfaces or steel extrusion parts that are not part of header construction. The Contractor shall perform mixing off the Bridge deck. The Contractor shall use plywood sheets and plastic sheeting to protect the Bridge deck for longer Bridges where this is not practical.

The Contractor shall place forms along the void edges, beneath the steel extrusions. The Contractor shall place and compact elastomeric concrete the entire length of the header to eliminate voids and leakage.

The Project Manager may reject the installation if the elastomeric concrete has any of the following characteristics:

1. Contains voids or honeycombs beneath steel extrusions;
2. Creates a poor finish;
3. Sets before being fully placed and consolidated;
4. Is not properly bonded to the steel and the concrete substrate; or
5. Shows signs of delamination.

562.3.7.1 Placement of Elastomeric Concrete in Vertical Recesses

At curb, Sidewalk, or barrier joint upturns, the Contractor shall follow procedures for placement of the elastomeric concrete into the vertical recesses without voids or honeycombs.

562.3.7.2 Heat Vulcanizing

The Contractor shall heat vulcanize the concrete after placement, if specified in the manufacturer's instructions.

562.3.8 Placement of Elastomeric Sealing Element

The Contractor shall provide and install the sealing element in one (1) continuous piece and in accordance with the manufacturer's instructions. The Contractor shall not field splice the sealing element, unless otherwise approved by the Project Manager.

562.3.9 Acceptance

The Contractor shall provide an installed seal that is undamaged and prevents moisture and other contaminants on the deck surface from leaking through the joints. After installation, the Contractor shall test the Bridge joint strip seals for leaks by flooding with water. The Contractor shall perform testing in the presence of the Project Manager.

562.4 METHOD OF MEASUREMENT

Bridge joint strip seal will be measured by the linear foot.

562.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Bridge Joint Strip Seal</i>	Linear Foot

562.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for Bridge joint strip seals and will not be measured or paid for separately:

1. Steel components of the Bridge joint strip seal;
2. Elastomeric concrete headers;
3. Leak Testing including water for leak test;
4. Providing manufacturers' technical representatives unless waived by Project Manager;
5. Elastomeric concrete installation certification;
6. Protective coating of steel components; and
7. Field welding of steel extrusions.

SECTION 563: POLYMER BRIDGE JOINT SEALS

563.1 DESCRIPTION

This Work consists of providing and installing polymer Bridge joint seals consisting of a rapid-curing silicone or polyurethane sealing element. The polymer joint sealant system may also be used at concrete element intersections when specified by the Contract Documents.

563.2 MATERIALS

563.2.1 General

The Contractor shall select sealing Material from the Department's *Approved Products List* for polymer Bridge joint seals.

563.2.2 Silicone Sealing Element

If using a silicone sealing element, the Contractor shall provide a two-part, rapid-curing, self-leveling, cold-applied silicone polymer Material that cures to a low-modulus rubber-like Material in accordance with Table 563.2.2:1, "Silicone Sealant Requirements."

The Contractor shall deliver each sealing compound lot or batch to the Project in the original sealed container. The Contractor shall indicate the manufacturer's name, batch and lot number on each container.

**Table 563.2.2:1
Silicone Sealant Requirements**

Property	Requirement
Tack-free time, 77 °F	30–60 min
Nonvolatile content, minimum	93%
Tensile strength and 24 h extension test	—
Initial, 5-Day cure, 77 °F	4–29 psi
After water immersion	4–29 psi
After heat aging,	4–29 psi
After cycling, –20 °F, 50%, 3 cycles	4–29 psi
24 h extension (all specimens) ^a	Pass

^aAfter 24 h, no evidence of cracks, separation, or other opening that at any point is over 1/8 inch deep in the sealant or between the sealant and backup blocks.

563.2.3 Polyurethane Sealing Element

If using a polyurethane sealing element, the Contractor shall provide a two-part joint sealant that cures quickly at ambient temperatures to form a flexible, resilient, tear-resistant rubber. The Contractor shall provide polyurethane sealant in accordance with Table 563.2.3:1, "Polyurethane Sealing Requirements."

The Contractor shall deliver each sealing Material lot or batch to the Project in the original sealed container. The Contractor shall indicate the manufacturer's name and batch and lot number on each container.

**Table 563.2.3:1
Polyurethane Sealing Requirements**

Property	ASTM	Requirement
Bond @ -20 °F, 50% extension (1/2 inch)		
Non-immersed	D 5329	Pass 3 cycles
Water-immersed	D 5329	Pass 3 cycles
Tensile adhesion, minimum	D 412	800%
Penetration		
@ -13 °F	D 5329	5/16 inch
@ 0 °F	D 5329	1/16 inch
Flow 5 h @ 200 °F	D 5329	0

563.2.4 Backer Rods

The Contractor shall provide backer rods in accordance with the sealant manufacturer's recommendations.

563.3 CONSTRUCTION REQUIREMENTS

563.3.1 Technical Representative

When installing Bridge joint sealants, the Contractor shall have the manufacturer's technical representative on site for the initial joint installation to advise the construction personnel and ensure a satisfactory joint installation. If the Contractor can show proof of satisfactory past experience installing at least ten (10) joints or 300 ft of joints of the same Material, whichever is larger, the Project Manager may waive this requirement.

563.3.2 Manufacturer's Instructions

The Contractor shall provide a complete set of written joint installation instructions to the Project Manager at least 14 Days before installing the joints.

563.3.3 Joint Preparation

The Contractor shall prepare the joint per the manufacturer's recommendations.

563.3.4 Inspection Before Installation

The Contractor shall inspect joints for proper depth, width, alignment, and preparation, and obtain Project Manager approval before installing the sealant Material.

563.3.5 Application of Sealing Element

The Contractor shall install a backer rod at least 25% larger in diameter than the joint opening, or a diameter specified by the manufacturer, to the specified depth. Before applying sealant, the Contractor shall prime the substrate surfaces in accordance with the sealant manufacturer Specifications.

The Contractor shall place sealant when the air and substrate temperatures are from 45 °F to 80 °F and maintain at or above 45 °F for at least four (4) h.

The Contractor shall apply sealant in accordance with the manufacturer's

recommendations, using an approved applicator.

563.3.6 Traffic

The Contractor shall not allow traffic on newly installed silicone or polyurethane sealing elements without Project Manager approval. Silicone or polyurethane sealants are normally ready for traffic upon removal of the traffic control devices.

563.4 METHOD OF MEASUREMENT

Polymer Bridge joint seals will be measured by the linear foot.

563.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Polymer Bridge Joint Seals</i>	Linear Foot

563.5.1 Work Included In Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Polymer bridge joint seal system;
2. Including material, labor, Certificate of Compliance;
3. All other costs associated with providing and installing of the joint systems; and
4. Technical representative unless waived by Project Manager.

SECTION 564: PREFORMED CLOSED CELL FOAM BRIDGE JOINT SEALS

564.1 DESCRIPTION

This Work consists of providing and installing preformed closed cell foam bridge joint seal systems in accordance with the manufacture’s recommendations and as approved by the Project Manager.

564.2 MATERIALS

564.2.1 General

The Contractor shall select sealing material and the nosing element from the Department’s Approved Products List for Preformed Closed Cell Foam Bridge Joints. The Contractor shall provide sealing, bonding and nosing elements from the same manufacturer.

564.2.2 Closed Cell Foam Joint Seal

The Contractor shall use a joint seal that:

1. is an impermeable, closed-cell, cross-linked, ethylene vinyl acetate, low density polyethylene copolymer, nitrogen blown foam material,
2. has a minimum working range of 60% compression and 30% tension,
3. meets or exceeds the requirements listed in Table 564.2.2:1 below,
4. has 1/8 inch deep by 1/8 inch wide grooves spaced at ¼ inch to ½ inch along both sides of the joint and running the entire length of the joint to increase bond surface area,
5. is resistant to degradation due to ultraviolet radiation,
6. is self-extinguishing, and
7. is resistant to abrasion, oxidation, oils, gasoline, Road salts and other petroleum products that may be spilled on the surface.

**Table 564.2.2:1
Minimum Requirements For Preformed Joint Sealer**

Property	Requirement
Service Range	-94 – 160 degrees F
Tensile Strength (ASTM D-3575, Suffix T)	110 psi min
Elongation at break (ASTM D-3575, Suffix T)	200 % average
Tear Resistance (ASTM D-624)	15 lb/inch min
Water Absorption (ASTM D-3573, Suffix L)	0.035 lb/ft ³ max
Density (ASTM D-3575)	2.6 – 4.0 psf
Weathering (ASTM G-154 or AASHTO T 42)	3000 Hrs No Chalking, Flaking, Blistering, Checking, and Cracking
Recovery (ASTM D-545)	97% min
Compression / Deflection	
@25% Deflection of original width(ASTM D-3575)	
@ 59% Deflection of original width(ASTM D-3575)	10 psi 20 psi

564.2.3 Bonder

The Contractor shall use a bonder that is a two (2) component, 100% solid epoxy adhesive designed to bond joint material to steel, cured concrete or wood, and is approved by the manufacturer.

564.2.4 Elastomeric Concrete

The Contractor shall use an elastomeric concrete that is mixed and applied according to the manufacturer's published recommendations and meets or exceeds the requirements listed in Table 564.2.4:1, "Minimum Requirements for Elastomeric Concrete," below.

**Table 564.2.4:1
Minimum Requirements For Elastomeric Concrete**

Property	Reference	Requirement
Compressive Strength	ASTM D 695	2,600 psi
Tensile Strength	ASTM D 638	775 psi
Elongation at Break		150%
Hardness, Shore D	ASTM D 2240	59
Water Absorption	ASTM D 570	< one percent (1%)
Density		9.4 lb/gal
Slant Shear Bond Strength		
Concrete		250 psi min
Steel		250 psi min
Resilience @ 5% Deflection	ASTM D 695	90% min

564.3 CONSTRUCTION REQUIREMENTS

564.3.1 General

The Contractor shall install the Joint sealant with a width 25% greater than the width of the joint opening at a near neutral condition (72 degrees F) according to the manufacturer's recommendations. The Contractor shall use the heat welding method for all directional changes in the joint sealant. The Contractor shall allow new concrete to cure for seven (7) Days, before installing the sealing material. The Contractor shall have all joint systems pre-approved by the Project Manager prior to placement. The Contractor shall use a Performance and Installation Enhancement (P.I.E.) bevel cut when the joint opening is greater than three (3) inches.

564.3.2 Technical Representative

The Contractor shall have the manufacturer's technical representative on site for the initial joint installation to advise the construction personnel and ensure a satisfactory joint installation. If the Contractor can show proof of satisfactory past experience installing at least ten (10) joints or 300 ft of joints of same Material, whichever is larger, the Project Manager may waive this requirement.

564.3.3 Manufacturer's Instructions

The Contractor shall provide a complete set of written joint installation instructions to the Project Manager at least 14 Days before installing the joints.

564.3.4 Surface Preparation

The Contractor shall prepare all surfaces in accordance with the manufacturer's instructions.

564.3.5 Existing or New Concrete To Concrete Joints

The Contractor shall clean surfaces of joint and remove debris. Sand blasting and/or mechanical abrasion of substrate may be required to remove debris. The Contractor shall place bonder and joint material against new or sound existing concrete.

564.3.6 Existing Concrete To Concrete or Concrete To Asphalt Joints

The Contractor shall remove unsound concrete or asphalt with a neat saw cut to a minimum size of two (2) inch depth and four (4) inches wide. The Contractor shall clean surfaces of joint and remove debris. The Contractor shall prime all surfaces with a primer acceptable to the manufacture and place elastomeric concrete. The Contractor shall place bonder and joint material against new elastomeric nosing after it has cured to 75% of its final strength.

564.3.7 Protection of joints

The Contractor shall provide protection of the joint from construction traffic.

564.4 METHOD OF MEASUREMENT

Preformed closed cell foam Bridge joint seals will be measured by the linear foot.

564.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Preformed Closed Cell Foam Bridge Joint Seals</i>	Linear Foot

564.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Preformed closed cell foam bridge joint seal system;
2. Including material, labor, certifications;
3. All other costs associated with providing and installing of the joint systems; and
4. Technical representative unless waived by Project Manager.

SECTION 565: PREFORMED SILICONE-COATED FOAM JOINT SYSTEM

565.1 DESCRIPTION

This Work consists of providing and installing preformed, pre-compressed, self-expanding foam with silicone pre-coated surface. The foam is bonded in place with a structural epoxy adhesive. The silicone pre-coated surface is sealed to the bridge with silicone sealant. This system is referred to herein as "joint system."

565.2 MATERIALS

565.2.1 Joint System

The Contractor shall provide 100% waterproof pre-compressed polymer impregnated open cell polyurethane foam topped with a silicone coating. The Contractor shall provide a joint system comprised of the following three (3) components:

1. Cellular polyurethane foam impregnated with 100% hydrophobic polymer, water based emulsion and factory coated with highway-grade, fuel resistant silicone;
2. Field-applied epoxy adhesive primer; and
3. Field-injected silicone sealant.

The Contractor shall provide a total system from a single manufacturer.

565.2.1.1 Open Cell Polyurethane

The Contractor shall provide a foam seal with the following properties:

1. Foam with a working range of 50% in tension and 50% in compression. Factory fabricate changes in plane and direction using factory fabricated watertight transition assemblies on inside and outside corners for 45 degrees and 90 degree bends;
2. Bleeding: none at 180 deg. F@ 50% compression for three (3) hrs;
3. UV Resistance, no changes 2000 hrs, in accordance with ASTM G155; and
4. Provide a polymer impregnation agent.

565.2.1.2 Epoxy Adhesive

The Contractor shall use 100% solids, two component moisture sensitive modified epoxy adhesive which meets ASTM C-881.

565.2.1.3 Silicone Sealant

The Contractor shall use a one part, cold applied chemically curing silicone joint sealant which meets ASTM D 5893. Silicone shall be fuel resistant.

565.3 CONSTRUCTION REQUIREMENTS

565.3.1 General

The Contractor shall be certified by the manufacturer for installation of the joint system. If the Contractor is not certified, the Contractor shall ensure that a technical representative from the manufacturer is present for the duration of the joint system installation.

565.3.2 Installation

The Contractor shall install the components of the joint system when the temperature is within the range specified by the manufacturer of each system component. The Contractor shall store Materials in accordance with the manufacturer's requirements.

The Contractor shall install field-applied epoxy adhesive primer and field-injected silicone sealant as directed by the manufacturer. Prior to installation, the Contractor shall measure the opening of the existing joint at different locations and compute the mean opening. The Contractor shall furnish the seal joint topped with fuel resistant silicone in a width greater than the mean measured joint extension which when compressed will form bellow(s) as recommended by the manufacturer. The Contractor shall furnish a foam seal having a depth appropriate for the joint width as recommended by the manufacturer.

The Contractor shall prepare surfaces to receive the sealant by grinding, sand blasting, and/or shot blasting concrete bond surfaces, or per the manufacturer's recommendations. For concrete surfaces, the Contractor shall repair spalls, chips, irregular or unsound joint surfaces to provide smooth joint surfaces in a manner approved by the Project Manager. The Contractor shall blast clean steel surfaces in accordance with SSPC-SP 6, "Industrial Blast Cleaning." After preparing the surface, the Contractor shall notify the Project Manager for inspection of the joint before installing the joint system. The Contractor shall ensure joint sides are dry of solvents or other cleaning agents prior to installation.

At deck edges, the joint Material shall not extend horizontally beyond the deck, but shall turn down and seal the deck edge in the vertical plane. The joint Material shall extend one (1) inch below the bottom of the deck.

When factory fabricated universal 90's are required, the Contractor shall start installation with these members. The Contractor shall apply epoxy adhesive to the sides of the joint header as directed by the manufacturer. The Contractor shall unwrap joint system and place in joint opening as directed by the manufacturer. The Contractor shall provide a minimum recess of 1/2 inch for joint sizes 1/2 - 1-1/4 inch and a minimum recess of 3/4 inch for sizes 1-1/2 - four (4) inch. Prior to placing joint system in the joint opening, the Contractor shall verify depth using a wooden block shaped in the form of a 'T.' Before the epoxy cures, the Contractor shall install a bead of silicone sealant between the foam and the silicone topping.

565.3.3 Acceptance Test Procedures

The Contractor shall perform a watertight integrity test of the joint system if required by the Project Manager. The test shall be observed by the Project Manager. The test results shall be photographically recorded and transmitted to the Project Manager. Unless otherwise directed by the manufacturer, the water integrity test shall be as follows: Wait a minimum of 72 hours after the joint is placed. The Contractor shall flood the joint with water. The Contractor shall visually verify that there are not any leaks on the underside of the joint as observed by the Project Manager. Joints that leak will not be accepted. The Contractor shall repair leaky joints in accordance with the manufacturer's recommendations.

565.4 METHOD OF MEASUREMENT

The joint system will be measured by the linear foot from end to end along the joint centerline.

565.5 BASIS OF PAYMENT

Pay Item	Pay Unit
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565.5.1 Work Included in Payment

The Department will consider as included in the payment for the joint system and will not measure or pay separately for the following Work:

1. All Material, labor and Certificate of Compliance;
2. All other costs associated with providing and installing of the joint system; and
3. Technical representative if required.

SECTION 570: PIPE CULVERTS

570.1 DESCRIPTION

This Work consists of supplying, constructing, and reconstructing pipe Culverts. Section 12 referred to below is from the AASHTO's LRFD Bridge Design Specification. Sections 26, 27 and 30 referred to below are from the AASHTO's LRFD Bridge Construction Specification.

570.2 MATERIALS

The Contractor shall provide Material in accordance with Table 570.2:1, "Culvert Material Applications."

**Table 570.2:1
Culvert Material Applications**

Category/Material	Application ^a				
	Sub-drainage	Cross Drains	Turnouts	Storm Drains ^b	Siphons ^c
Metal (steel or aluminum or steel reinforced polyethylene)					
xCMP	X	X	X		
xSpiral Rib Pipe		X	X	X	
xDouble Wall				X	
xSmooth FLO				X	
xConcrete Lined				X	
Concrete					
Reinforced	X	X	X	X	
xPressure					X
xCylinder					X
Precast CBC ^h		X	X	X	
Polypropylene					
Corrugated ^j	X	X	X	X	
Triple wall ^k	X	X	X	X	
Thermoplastic, high density polyethylene (HDPE)					
Single Wall Pipe ^d	X				
Corrugated	X	X	X	X	
xProfile ^e	X	X	X	X	
xSolid	X			X	X
Thermoplastic, PVC					
xCorrugated (in/out)	X	X	X		
xProfile ^f	X	X	X	X	
xSolid	X ^g			X	
Pressure					X
Miscellaneous					
Ductile Iron					X
xSRPE ^v	X	X	X	X	

**Table 570.2:1
Culvert Material Applications**

Category/Material	Application ^a				
	Sub-drainage	Cross Drains	Turnouts	Storm Drains ^b	Siphons ^c
X denotes an acceptable application.					
A "blank cell" denotes an unacceptable application.					
^a Primary Applications (Could be used in other applications as approved by the Project Manager).					
^b Joints must be watertight in accordance with Section 570.2.2, "Joints," and have a maximum tested Manning's coefficient roughness of 0.013 or less.					
^c Must meet the pressure tight requirements of Section 570.2.2, "Joints."					
^e Type S, Type D, or ASTM F 894.					
^f ASTM F 794, F949, and ASTM F 1803.					
^g Schedule 40.					
^h For Precast box, refer to Special Provision 511 – F, if applicable.					
ⁱ ASTM F2736 and MP-21-11.					
^k ASTM F2764.					
^v Steel Reinforced Polyethylene Pipe.					

The Contractor shall design, manufacture, and install Culvert Materials in accordance with Table 570.2:2, "Culvert Materials Specifications, AASHTO LRFD (AWWA)," and Table 570.2:3, "Culvert Materials Specifications, ASTM (ACI)."

**Table 570.2:2
Culvert Materials Specifications, AASHTO (ANSI/AWWA)**

Category/parameters	Material	Pipe	Design ^a	Installation ^a
Corrugated metal pipe and pipe arch				
Galvanized	M 218	M 36	Section 12	Section 26
Aluminized, Type 2	M 274	M 36	Section 12	Section 26
Aluminum	M 196	M 196	Section 12	Section 26
Fiber-bonded	M 190, A	M 190, A	Section 12	Section 26
Polymeric	M 246	M 245	Section 12	Section 26
Coatings pavements and lining				
Asphalt coating	—	M 190, A	—	—
Concrete lined	—	M 36	—	—
Paved invert	—	—	M 190, B&C	—
Low n value	—	M 190, A	—	—
Reinforced concrete				
Round	—	M 170	Section 12	Section 27
Arch	—	M 206	Section 12	Section 27
Elliptically shaped	—	M 207	Section 12	Section 27
Reinforced D-load	—	M 242	Section 12	Section 27
Cylinder	—	C 303	AWWA M9	—

**Table 570.2:2
Culvert Materials Specifications, AASHTO (ANSI/AWWA)**

Category/parameters	Material	Pipe	Design^a	Installation^a
Pressure	—	C 302	AWWA M9	—
Polypropylene				
Pipe 12 inch-- 30 inch	MP-21	MP-21	Section 12	Section 30
Pipe 36 inch – 60 inch	MP-21	MP-21	Section 12	Section 30
Thermoplastic, HDPE corrugated				
Pipe 3 inch–10 inch	—	M 252	—	—
Pipe 12 inch–60 inch	—	M 294	Section 12	Section 30
Thermoplastic, HDPE profile				
Profile 18 inch–120 inch	—	—	Section 12	Section 30
Thermoplastic, HDPE solid smooth				
Pipe 12 inch–60 inch	—	—	Section 12	Section 30
Thermoplastic, PVC profile				
Profile 4 inch–48 inch	—	M 304	Section 12	Section 30
Thermoplastic, PVC solid smooth				
Pipe 4 inch–15 inch	—	M 278	Section 12	Section 30
Pipe 18 inch–27 inch	—	—	Section 12	Section 30
Thermoplastic, PVC pressure				
Pipe 14 inch–36 inch	—	C 905	—	C 900 & M-23
Miscellaneous				
Ductile Iron Pipe	—	ANSI/ AWWA C150/ A21.50	ANSI/ AWWA C150/ A21.50	ANSI/ AWWA C600

Steel reinforced
Polyethylene Pipe D3350
24 inch – 96 inch

^aInstall in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures," Section 663, "Utility Items," for Pressure Pipe.

^bMust be approved by the Project Manager.

^dNMDOT approved thru 96 inch.

If flowable fill is used as backfill, Section 30 deflection testing may be performed immediately after the flowable fill has cured in accordance with Section 516, "Flowable Fill."

**Table 570.2:3
Culvert Materials Specifications, ASTM (ACI)**

Category/parameter	Material	Pipe	Design	Installation^a
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**Table 570.2:3
Culvert Materials Specifications, ASTM (ACI)**

Category/parameter	Material	Pipe	Design	Installation^a
Corrugated metal pipe and pipe arch				
Galvanized	A 929	A 760	A 796	A 798
Aluminized, Type 2	A 929	A 760	A 796	A 798
Aluminum	B 744	B 745	B 790	A 798
Fiber-bonded	A 885	A 760	A 796	A 798
Polymeric	A 742	A 762	A 796	A 798
Coatings, pavement, and lining				
Asphalt coating	—	A 849	—	—
Concrete lined	—	A 849	—	—
Paved invert	—	A 849	—	—
Low n value	—	A 849	—	—
Reinforced concrete				
Round	—	C76	—	C 1479
Arch	—	C506	—	—
Elliptically shaped	—	C507	—	—
Reinforced D-load	—	C655	—	C 1479
Cylinder	—	—	—	—
Pressure	—	C 361	C 361	—
Non-reinforced concrete^c				
<36 inch	—	C 14	—	C 1479
Cast-in-place Concrete ^d	—	ACI 346	—	—
Polypropylene				
Pipe 12 inch – 30 inch	F 2736	F 2736	—	D 2321
Pipe 36 inch – 60 inch	F 2881	F 2881	—	D 2321
Pipe 30 inch – 60 inch	F 2764	F 2764	—	D 2321
Thermoplastic, HDPE corrugated				
Pipe 3 inch–10 inch	D 3350, 335420C	—	—	D 2321
Pipe 12 inch–60 inch	D 3350, 324420C	—	—	D 2321
Thermoplastic, HDPE profile				
Profile 18 inch–120 inch	D 3350, 334433C	F 894 ^b	—	D 2321
Thermoplastic, HDPE solid smooth				
Pipe 12 inch–60 inch	D 3350, 335434C	F 714	—	D 2321
Thermoplastic, PVC profile				
Profile 4 inch–48 inch	D 1784, 12364C	F 794, F949, F 1803	—	D 2321
Thermoplastic, PVC solid smooth				

**Table 570.2:3
Culvert Materials Specifications, ASTM (ACI)**

Category/parameter	Material	Pipe	Design	Installation^a
Pipe 4 inch–15 inch	D 1784, 12454	D 3034, F 679	—	D 2321
Pipe 18 inch–27 inch	D 1784, 12454	F 679	—	D 2321
Thermoplastic, PVC pressure				
Pipe 14 inch–36 inch	D 2241	—	D 3139	D 2321
Miscellaneous				
Ductile Iron Pipe	—	A716	A 746	—
Steel reinforced Polyethylene Pipe 24 inch – 96 inch	D3350	F2562	---	D 2321

^aInstall in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures," Section 663, "Utility Items," for Pressure Pipe.

^bUse R. S. C. = 100 and 160 only.

^cMust be approved by the Project Manager.

570.2.1 Pipe

570.2.1.1 Metal Pipe

The Contractor shall provide helical corrugated pipe that have re-rolled ends with at least two (2) annular corrugations. If using stab joints, only one (1) end may have a factory attached coupling as appropriate for the end.

The following ends of pipe do not have to be re-rolled:

1. Connected to an existing pipe with helical corrugations;
2. Connecting to an end section; or
3. To be embedded in concrete.

The Department will allow direct connection of end sections utilizing a dimple band for cut ends on existing pipe, and straps or rods on new installations.

The Contractor shall use a half smooth, half corrugated sleeve or a concrete collar for extensions of concrete pipe to metal pipe.

If using smooth interior lined steel Culvert pipe (double wall), the Contractor shall provide lock seams of the smooth interior liner and the corrugated shell that are continuous from end to end of each length of pipe section. The Contractor shall ensure the exterior gauge is not less than the specified gauge in the Contract for unlined corrugated steel Culvert pipe. The interior metal lines shall be at least 0.040 inch.

The Contractor shall use pipe with gasketed lock seams and re-rolled ends for watertight installations. Joints must meet the requirements per Section 570.2.2.1.2, "Watertight Joints."

570.2.1.2 Reinforced Concrete Pipe

The Contractor shall provide reinforced concrete pipe (RCP) with a bell and spigot design, a tongue and groove design or a single offset joint design. All RCP shall be fabricated

in a plant that is certified by the American Concrete Pipe Association (ACPA).

The Contractor may use lift holes or lifting anchors to handle and place RCP. The Contractor shall not use more than two (2) lift holes in the wall of each piece of pipe. The Contractor shall place lift at the top of the pipe in line with the centerline of the pipe and along the minor axis of the reinforcement. When using a single lift hole, the Contractor shall place it at the balance point. When using two (2) lift holes, the Contractor shall place them equidistant from the balance point. The lift holes shall not interfere with the load carrying capacity of the pipe, shall be neatly made, shall be straight, and may be either drilled or cast.

After the Contractor has placed the pipe and before beginning backfill operations, the Contractor shall fill the lift holes with:

1. Non-shrink grout, in accordance with Section 521, "Non-Shrink Grout;"
2. Joint mortar, in accordance with Section 570.2.2.2.2, "RCP Joint Material," to which non-shrink admixture in accordance with Section 521, "Non-Shrink Grout" has been added; or
3. Non-shrink grout, in accordance with Section 521, "Non-Shrink Grout."

570.2.1.3 Plastic Pipe

When required for thermoplastic pipe, the Contractor shall provide end sections located out of the clear zone that are either metal or HDPE with a minimum two percent (2%) carbon black in accordance with ASTM D 1248.

570.2.1.4 Pipe Certification and Identification Requirements

The Contractor shall provide certified test results showing that the Material supplied meets Specifications.

The Contractor shall provide record heat numbers and supply chemical analysis for metal pipe. The Department will inspect the RCP factory out of state RCP Suppliers shall arrange for witnessed plant tests at no additional cost to the Department. The Contractor shall provide certification of cell classification and pipe stiffness for thermoplastic pipe in accordance with the Material selected using the fill height table in the Standard Plans.

The Contractor shall label each pipe before shipment. All thermoplastic pipe sections will clearly display the "Date Code Number." RCP will display NMDOT stamp. Metal pipe will display a stencil or stamp displaying the manufacturer's name, date and country of manufacture, thickness, coating, heat number, and applicable ASTM or AASHTO Specification. All labels will correspond to test reports with a permanent print, stamp, or stencil.

The Contractor shall provide test reports and certification for in plant joint tests required by Section 570.2.2.1.2, "Watertight Joints."

570.2.1.5 Selecting Pipe

The Contractor may select any approved type of pipe, unless otherwise specified.

If the Plans specify storm drain Culvert pipes, the Contractor may select an approved type with a maximum tested Manning's coefficient of roughness of 0.013.

If the Plans specify siphon Culvert pipes, the Contractor may select an approved pressure pipe.

The Contractor shall select a type of pipe based on the corrosion resistance number in accordance with Section 570.2.3.1, "Corrosion Resistance Number," except when using siphon Culvert pipe.

If the Plans specify a nominal diameter for pipe arch, the Contractor may supply arched or elliptical pipe equal to the nominal round pipe.

570.2.2 Joints

The Contractor shall select the appropriate joint in accordance with Table 570.2.2:1, "Joint Selection."

**Table 570.2.2:1
Joint Selection**

Type of pipe Structure	Soil-tight	Water-tight	Pressure Tight	Restrained
Culverts under turnouts (not under Road)	X			
Cross drain Culverts	X			
Elbowed drop Culverts		X		X ^{a, c}
Storm drains		X ^b		
Rundowns or downdrains ^a		X		X ^{a, c}
Pond outlet pipes and risers		X		
Irrigation pipe (non-pressure)		X ^b		
Irrigation siphons and sag pipes (pressure)			X	

^aUse where pipe slopes are steep (>10%) and or velocities are high.

^bTongue and groove joints for Elliptical and Arched Concrete, and Steel Arch pipe are not considered watertight without special joint design considerations (for RCP refer to Section 570.2.2.2.2, "RCP Joint Material;" for CMP refer to Section 570.2.2.2.1, "CMP Joint Material") or as approved by the Project Manager.

^cRCP and CMP only.

570.2.2.1 Joint Types

570.2.2.1.1 Soil-tight Joints

A soil-tight joint does not allow migration of soil into the pipe.

570.2.2.1.2 Watertight Joints

A gasketed joint restricts infiltration/exfiltration and exhibits no visible leakage when subject to 10.8 psi over the crown for ten (10) min under testing conditions as outlined in the appropriate product ASTM Specification.

When plant tested, the appropriate product joint shall meet the requirements of ASTM D 3212 (thermoplastic or steel reinforced **polyethylene**), ASTM C 443/C 497 (concrete) or ASTM-A760 (metal).

570.2.2.1.3 Pressure-tight Joints

The Contractor shall use pressure pipe in accordance with Section 663, "Utility Items," and the associated sections of the *New Mexico Standard Specifications for Public Works Construction (NMSSPWC)*. The Contractor shall provide pipe with a pressure rating equal to or greater than the static head shown on the drawings. The Contractor shall select Materials in accordance with Table 570.2.2.1.3:1 "Pressure-Tight Joint Materials."

The Contractor shall test pressure-tight installations used in siphons and sag pipes shall show no leakage in excess of the allowable line leakage requirement when filled with water to the highest operating elevation and allowed to stand full for 24 h.

The minimum coupling requirement will be in accordance with the testing requirements of AASHTO's *LRFD Bridge Construction Specifications*, Section 26 & 30, for standard joints in non-erodible soils.

**Table 570.2.2.1.3:1
Pressure-Tight Joint Materials**

Material	NMSSPWC Section
Polyvinyl chloride	121 (AWWA C 905)
Reinforced concrete	124 (ASTM C 361M)
Concrete cylinder	128 (AWWA C 303)
Ductile iron	129 (ANSI/AWWA C150/A21.50)
Ductile and cast iron fittings	130 (ANSI/AWWA C153/A21.53 & ANSI/AWWA C111/A21.11)
Solid wall HDPE	ASTM F 714

570.2.2.1.4 Restrained joint

A restrained joint resists a tensile force in accordance with AASHTO's *LRFD Bridge Construction Specifications*, Section 26 or as approved by the Project Manager.

570.2.2.2 Joint Materials

570.2.2.2.1 CMP Joint Material

If the Contract specifies soil-tight joints, factory-attached metal or plastic stab joints with modified gaskets, hugger-type bands without gaskets or fully corrugated bands without gaskets can be supplied.

If the Contract specifies watertight joints, the requirements of Section 570.2.2.1.2, "Watertight Joints" must be met, which shall include the following: Factory-attached metal or plastic stab joints with modified gaskets, or hugger-type bands with lubed O-ring gaskets, is watertight when backfilled with flowable fill. With round pipe a minimum of 5C fully corrugated bands (13 inch wide) with a lubed, 12 inch wide, closed cell neoprene flat gasket is watertight without flowable fill. With pipe arch a minimum of 5C fully corrugated bands (13 inch wide) using rods and lugs with a lubed, 12 inch wide, closed cell neoprene flat gasket is watertight without flowable fill.

If the Contract specifies restrained joints all pipe affected will use rods and lugs.

570.2.2.2.2 RCP Joint Material

The Contractor shall provide flexible watertight sealing gaskets in accordance with ASTM C 443, ASTM C 877, or AASHTO M 198 for watertight applications.

The Contractor shall provide external sealing bands in accordance with ASTM C 877 for arch and elliptical pipes with tongue and groove joints in watertight applications.

The Contractor shall provide closed-cell neoprene gaskets in accordance with ASTM D 1056 and AASHTO M 198, Type B when required on the Contract.

The Contractor shall provide butyl rubber mastic sealant in accordance with AASHTO M 198 for soil-tight applications for round, arch, and elliptical concrete pipe.

The Contractor shall grout watertight and pressure-tight joints as directed by the Project Manager.

570.2.2.2.3 Thermoplastic and Steel Reinforced Polyethylene Joint Material

The Contractor shall provide couplings that snap on, and engage an equal number of corrugations on either side of the pipe joint. The Department will not accept wrap-around bands.

The Contractor shall provide bell and spigot joints in accordance with ASTM D 3212 and ASTM F 477.

The Contractor shall provide concrete Structure connections with a water stop or boot.

570.2.2.2.4 Thermoplastic (Polypropylene) Joint Material

The Contractor shall provide bell and spigot joints in accordance with ASTM D3212 and ASTM F477. Spigot shall have two (2) gaskets installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. The bell shall be reinforced with a polymer composite band installed by the manufacturer.

570.2.3 Durability

570.2.3.1 Corrosion Resistance Number

Unless specified on the Contract, the Contractor shall provide pipe Culverts with a minimum corrosion resistance number of CR1. However, the Contractor shall provide pipe Culverts with a minimum corrosion resistance number of CR3 for storm drains, rundowns, non-pressure irrigation pipe, and elbowed drop Culverts. If the Contract specifies a corrosion resistance number, the Contractor shall use Table 570.2.3.1:1, "Pipe Culvert Durability," to choose a pipe type from the column below the corrosion resistance number. The Contractor shall not use Table 570.2.3.1:1, "Pipe Culvert Durability," for siphon Culvert pipe.

**Table 570.2.3.1:1
Pipe Culvert Durability**

Type of pipe	Corrosion resistance number						
	CR1	CR2	CR3	CR4	CR5	CR6	CR7
Galvanized steel	Yes	No	No	No	No	No	No
Aluminized steel, Type 2 ^a	Yes	Yes	Yes	Yes	No	No	No
Aluminum alloy	Yes	Yes	Yes	Yes	Yes	No	No

**Table 570.2.3.1:1
Pipe Culvert Durability**

Type of pipe	Corrosion resistance number						
	CR1	CR2	CR3	CR4	CR5	CR6	CR7
RCP, Type II cement ^b	Yes	Yes	Yes	Yes	Yes	Yes	No
Polymeric coated steel	Yes	Yes	Yes	Yes	Yes	Yes	No
Aramid fiber bonded steel	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Thermoplastic ^c	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Steel reinforced and non-reinforced polyethylene pipe	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RCP Type V cement ^b	Yes	Yes	Yes	Yes	Yes	Yes	Yes

^aThe table is based on a minimal structural gauge thickness. The Contractor may use a heavier gauge to increase the corrosion resistance number as approved by the Project Manager.

^bCement type based on Section 510, "Portland Cement Concrete." If pH \leq 5.0, use a rapid chloride permeability \leq 1,200 coulombs.

^cCell Class corresponding to highest values on Fill Height Table must be used for CR4 – 7.

570.2.3.2 Dissimilar Metal Pipe Joints

The Contractor shall use rubber gaskets on joints between dissimilar metal pipes.

570.2.3.3 Coating Aluminum and Aluminized Steel Pipe, Type 2

The Contractor shall coat aluminum and aluminized steel pipe, Type 2 for the entire length of pipe in contact with fresh concrete (except for grouted pipe or flowable filled pipe) to a distance of 12 inch beyond the back face of the concrete in accordance with the Contract. The Contractor shall provide a zinc-rich paint coating in accordance with AASHTO M 36.

570.3 CONSTRUCTION REQUIREMENTS

570.3.1 General

The Contractor shall install pipe in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures" and the requirements of Table 570.2:2, "Culvert Materials Specifications, AASHTO (AWWA)," and current AASHTO *LRFD Bridge Construction Specifications* section applying to the pipe type. The Contractor shall ensure that no "floating" occurs during installation of pipe Culverts.

The Contractor shall use siphon Culvert pipe in accordance with Section 663, "Utility Items," and the associated sections of the *NMSSPWC*.

570.3.2 Excavation and Backfill

The Contractor shall excavate trenches in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures." The Contractor shall make the trenches wide enough to properly join the pipe and thoroughly compact the bedding Material under and around the pipe. Where possible, the Contractor shall make the trench wall vertical. When

using flowable fill for backfill, in accordance with Section 516, "Flowable Fill," the Contractor shall make trench widths in accordance with AASHTO's *LRFD Bridge Construction Specifications*, Section 26 for metal pipe and steel reinforced polyethylene pipe; Section 27 for RCP; and Section 30 for thermoplastic pipe. The Contractor shall refer to NMDOT 206 Standard Drawings for additional pipe installation requirements.

570.3.3 Fill Height Requirements

The Contractor shall verify minimum and maximum cover over the pipe in accordance with the Standard Drawings. If the cover for the pipe is less than the minimum or greater than the maximum, contact the State Bridge Engineer for direction.

570.3.4 Laying Pipe

The Contractor shall begin laying pipe at the downstream end of the pipeline except for extensions of existing pipes. The Contractor shall place the bottom of the pipe in contact with the shaped bedding throughout its full length.

The Contractor shall place the bell ends or outside circumferential laps of pipes facing upstream to obtain a shingling effect. The Contractor shall place pipe with longitudinal laps or seams with the laps or seams at the sides.

The Contractor shall lay paved or partially lined pipe so that the longitudinal centerline of the paved segment coincides with the flow line. The Contractor shall place elliptical and elliptically reinforced pipes with the major axis within five degrees (5°) of a horizontal plane.

570.3.5 Joining Pipe

570.3.5.1 Joining RCP

The Contractor shall join pipe sections so that the ends are fully centered and the inner surfaces are flush within the inside diameter tolerance variations of AASHTO M 170, but shall not exceed 5/8 inch.

The Contractor shall make watertight joints with the following:

1. Cement grout;
2. Flexible watertight gaskets;
3. External sealing bands; or
4. Any combination of these types.

For grouted joints, molds or runners shall be used to retain the poured grout. Flexible watertight gaskets shall be installed to form a flexible watertight seal.

If using portland cement mixtures, the Contractor shall protect the completed joints against rapid drying with a curing method approved by the Project Manager. The Contractor shall replace coupling systems that do not fit snugly, in accordance with Section 570.2.1.2, "Reinforced Concrete Pipe," at no additional cost to the Department.

570.3.5.2 Joining Flexible Pipe

The Contractor shall join metal or thermoplastic pipe with a flexible pipe coupling system. The Contractor shall ensure the coupling systems engage an equal number of corrugation or length on either side of the pipe joint. The Contractor shall replace coupling systems that do

not fit snugly to the pipe ends, in accordance with Section 570.2.2.2.1, "CMP Joint Material," and Section 570.2.2.2.3, "Thermoplastic Joint Material," at no additional cost to the Department.

The Contractor shall use dimpled bands to attach end sections. The Contractor shall ensure the dimples fit snugly within the given pipe's corrugations. If the dimpled band connections do not fit correctly, the Contractor shall use an alternate way to connect the pipes.

Where joints must have beveled ends to meet construction requirements, the Contractor shall form a continuous unit in accordance with the Plans.

The Contractor shall make water tight joints using a bell and spigot conforming to ASTM D3212 and F477. The Contractor shall push spigot into bell end so spigot reaches homing mark on bell end.

The Contractor shall repair damaged protective coatings in accordance with AASHTO M 36 at no additional cost to the Department.

570.3.5.3 Pipe Installation Inspection

The Contractor shall inspect the pipe before placing any backfill. The Contractor shall replace or re-lay unacceptable pipe at no additional cost to the Department.

The Contractor shall ensure that pipe is installed in full compliance with AASHTO's *LRFD Bridge Construction Specification*, Section 26 (metal and steel reinforced polyethylene pipe), Section 27 (RCP) or Section 30 (thermoplastic) requirements.

For thermoplastic pipe, the Contractor shall provide the Department with the results of the deflection test detailed in Section 30 of AASHTO's *LRFD Bridge Construction Specification* and a certification that the testing was completed. The required deflection testing shall be performed at no additional cost to the Department.

570.3.5.4 Salvaging Culvert Pipe

The Contractor shall remove Culvert pipe to be salvaged or reinstalled from the existing location in accordance with Section 601, "Removal of Structures and Obstructions." The Contractor shall clean salvaged pipe of Deleterious Material before storing or reinstalling.

570.4 METHOD OF MEASUREMENT

The Department will measure all pay items using the dimensions shown in the Contract or approved modifications.

570.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Culvert Pipe</i>	Linear Foot
<i>Culvert Pipe End Section</i>	Each
<i>Culvert Pipe Arch</i>	Linear Foot
<i>Culvert Pipe Arch End Section</i>	Each
<i>Storm Drain Culvert Pipe</i>	Linear Foot
<i>Storm Drain Culvert Pipe End Section</i>	Each

<i>Storm Drain Culvert Pipe Arch</i>	Linear Foot
<i>Storm Drain Culvert Pipe Arch End Section</i>	Each
<i>Siphon Culvert Pipe</i>	Linear Foot
<i>Reinstalling Culvert Pipe</i>	Each

The Department will pay for the removal of Culvert pipe in accordance with Section 601, "Removal of Structures and Obstructions."

The Department will pay for Culvert pipe cleaning in accordance with Section 613, "Cleaning of Culverts and Drainage Structures" when specified on the Plans.

The Department will pay for excavation for Culverts in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

570.5.1 Work Included in Payment

The following Work and items shall be considered as included in the payment for the major items and will not be measured or paid for separately:

1. All joint Materials, shear connectors required for joining sections;
2. Testing and Certification of all Culverts; and
3. The coating of aluminum and aluminized steel pipe Type 2 when placed with fresh concrete. Removal of Culvert pipe shall be paid for in accordance with Section 601, "Removal of Structures and Obstructions." Excavation for Culverts shall be measured and paid for in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures." Siphon Culvert pipe Work shall include trenching, connections to transitions, pipe joining, dewatering, installation of pipe, fittings miscellaneous components; including elbows, drains and blowoffs, backfill and compaction, encasing or special backfill and hydrostatic testing.

SECTION 571: STRUCTURAL PLATE STRUCTURES

571.1 DESCRIPTION

The Work consists of providing and installing pipe, pipe arches, long span Structures or metal box Culverts made of metal structural plate and foundation elements for such structures, in accordance with Table 571.1:1, "Structural Plate Specifications: AASHTO," and Table 571.1:2, "Structural Plate Specifications: ASTM."

**Table 571.1:1
Structural Plate Specifications: AASHTO**

Category/parameter	Material	Design^a	Installation^b	Backfill
Structural plate				
Galvanized	M 167	Sect. 12	Sect. 26	M 145
Aluminum	M 219	Sect. 12	Sect. 26	M 145
Box Culvert				
Aluminum	M 219	Sect. 12	Sect. 26	M 145
Galvanized	M 167	Sect. 12	Sect. 26	M 145
Coatings, pavements, and linings				
Asphalt coating	—	—	M 243M	—
Paved invert	—	—	—	—

^aAASHTO LRFD Bridge Design Specifications
^bAASHTO LRFD Bridge Construction Specifications

**Table 571.1:2
Structural Plate Specifications: ASTM**

Category/parameter	Material	Design	Installation	Backfill
Structural plate				
Galvanized	A 761	—	A 807	—
Aluminum	B 746	B 790	B 789	—
Box Culvert				
Aluminum	B 864	—	B 789	—
Galvanized	A 964	—	A 807	—
Coatings, pavements, and linings				
Asphalt coating	—	—	A 849	—
Paved invert	—	—	A 849	—
Nuts and bolts				
Galvanized plate	A 449	—	—	—
Aluminum plate	A 307 or A 449 & A 153	—	—	—
Aluminum box Culvert	A 307 or A 449 & A 153	—	—	—

571.2 MATERIALS

571.2.1 General

The Contractor may provide aluminum or steel Structures, unless otherwise specified in the Contract.

The Contractor shall not mix aluminum and steel Materials in an installation, except as specified for galvanized steel bolts and nuts on structural aluminum plate Structures.

571.2.2 Structural Plates

The Contractor shall provide steel structural plates in accordance with AASHTO M 167.

The Contractor shall provide aluminum structural plates in accordance with AASHTO M 219.

571.2.3 Fasteners

The Contractor shall provide fasteners for steel structural plates in accordance with AASHTO M 167.

The Contractor shall provide fasteners for aluminum plate Structures in accordance with AASHTO M 219.

571.2.4 Asphalt Coating

If required, the Contractor shall protect structural plate Structures with asphalt coating in accordance with AASHTO M 190. The Contractor shall provide field-applied coatings in accordance with AASHTO M 243.

The Contractor shall coat the fasteners extending outside of the pipe after installation. The Contractor may leave the portions of the fasteners extending inside the pipe uncoated.

571.2.5 Design and Certification Requirements

571.2.5.1 Design

The Contractor is responsible for the structural and foundation designs of metal box Culverts and other structural plate Structures. Geotechnical boring log summaries and hydraulic scour depths will be provided by NMDOT. The Contractor shall design structural plate Structures in accordance with Section 10 and 12 of AASHTO's *LRFD Bridge Design Specification*.

At least 30 Days before beginning fabrication, the Contractor shall submit to the Project Manager three (3) sets of the following Stamped by a New Mexico Professional Engineer:

1. Complete design calculations;
2. Working Drawings; and
3. Construction details and installation instructions for long-span structural plate Structures and metal box Culverts.

New Mexico Professional Engineer Stamp and foundation designs are not required for Structural plate Structures with structural inverts under 18 feet maximum. The Project Manager will return one (1) set, with notations, to the Contractor within 14 Days. The Contractor shall make the appropriate corrections and resubmit eight (8) sets of calculations and Working Drawings to the Project Manager for final review and approval. Seven (7) additional Days shall be allotted for final review.

The Contractor shall not fabricate Materials until receipt of written notification of the Department's Working Drawings approval.

571.2.5.2 Certifications

The Contractor shall provide certificates to the Project Manager in accordance with Section 12 of AASHTO M 167 for Steel Structural Plates or Section 11 of AASHTO M 219 for Aluminum Structural Plates, and the Specifications, before installing the Structure at the Project site.

571.3 CONSTRUCTION REQUIREMENTS

571.3.1 Assembling

When practical, the Contractor shall connect plates with the seams and stagger them so that no more than three (3) plates come together at one (1) point.

The Contractor shall assemble structural plate Structures using bolts with a minimum 3/4 inch diameter.

If assembling steel structural plates, the Contractor shall apply from 100 lbf•ft to 300 lbf•ft of torque.

If assembling aluminum structural plates, the Contractor shall apply from 100 lbf•ft to 200 lbf•ft of torque.

The Contractor shall tighten the longitudinal seams of joined plates, except for plates held in shape by cables, struts, or backfill.

571.3.1.1 Assembly Tolerances

The Contractor shall ensure that the plates do not vary from the specified dimension before backfill by more than two percent (2%) of the longest dimension (span or rise) or five (5) inches, whichever is less. However, the Contractor shall only apply the two percent (2%) restriction for horizontal ellipse shapes having a ratio of top to side radii of three (3) or less. When the rise of arches with a ratio of top to side radii of three (3) or more, the Contractor shall ensure that they do not vary from the specified dimension by more than one percent (1%) of the span.

571.3.1.2 Welding

The Contractor shall weld steel in accordance with ANSI/AASHTO/AWS Bridge Welding Code D1.5. The Contractor shall weld aluminum in accordance with AWS Structural Welding Code D1.2.

The Contractor shall ensure that qualified welders perform shop and field welding in accordance with Section 5 of ANSI/AASHTO/AWS Bridge Welding Code D1.5.

The Contractor shall perform welding on steel plates (other than fittings) before galvanizing.

571.3.2 Rejection of Damaged Materials

The Department may reject damaged or defective structural plate Structures or structural plates at any time during the construction operations, regardless of prior approval.

The Contractor shall replace installed Structures or plates that are damaged or that fail to

meet the restrictions of structure shape in accordance with Section 571.3.1.1, "Assembly Tolerances," at no additional cost to the Department.

571.3.3 Movement Monitoring

In long span structural plate Structures; the Contractor shall place movement control devices at locations specified by the manufacturer for the entire length of the Structure. The Contractor shall ensure that a qualified manufacturer's representative continually monitors long-span structural plate Structures for movement to detect excessive distortion of the Structure shape due to progressive plate assembly, and Equipment and backfilling operations. Long span structural plate structures are defined in Section 12.8 of the AASHTO *LRFD Bridge Design Specifications*.

The Department will determine excessive distortion in accordance with Section 571.3.1.1, "Assembly Tolerances," and as a radius change more than 33% of the lower side plate of high-profile arches and the side plate of pear-shaped Structures.

Upon completion of the Structure, the Contractor shall submit the movement measurement records to the Project Manager with a statement certifying that any movements were within acceptable limits.

571.3.4 Excavation

The Contractor shall perform excavation in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

571.3.5 Bedding and Backfill

The Contractor shall construct bedding Material for Culverts with closed bottoms in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

The Contractor shall ensure that the backfill and bedding are in accordance with Table 571.3.5:1, "Electrochemical Criteria," to ensure a 50-year service life.

**Table 571.3.5:1
Electrochemical Criteria**

Type of Material	pH AASHTO T 288	Resistivity, ohm-cm AASHTO T 288	Soluble salts, SO₄,% by weight
Galvanized steel 2 oz. coating	5.8–8.0	>2,000	0.05
Galvanized steel 3 oz. coating	5.0–10.0	>2,000	0.05
Asphalt coating	^a	>2,000	0.075
Aluminum plate	4.0–9.0	>500	0.125

^aLower the pH range of the galvanized pipe by one (1).

571.3.6 Backfill

The Contractor shall ensure that backfill Material is in accordance with soil classification A-1 or A-3 in AASHTO M 145, and compact it to at least 90% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

To avoid damaging the Structure, the Contractor shall compact the initial two (2) ft of backfill over the crown of the Structure with hand held Equipment or small compaction machinery. The Department defines the crown as the area between the points of compound curvature of top and side plates or the area between the location of longitudinal structural stiffeners.

The Department will not apply density requirements to the first two (2) lifts of backfill placed over the crown of the Structure. The Contractor shall not allow heavy machinery on the Structures, except for metal box Culverts, until the fill over the Structure is at least four (4) ft deep, or 1/5 of the span, whichever is greater.

571.3.7 Repair of Damaged Coating

The Contractor shall repair damaged protective coating in accordance with AASHTO M 167 at no additional cost to the Department. The Contractor shall use zinc-rich paint in accordance with Section 546 Recoating Structures.

571.4 METHOD OF MEASUREMENT

The Department will measure all Structural Plate Structure pay items by the linear foot.

571.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Structural Plate Pipe</i>	Linear Foot
<i>Structural Plate Pipe Arch</i>	Linear Foot
<i>Metal Box Culvert</i>	Linear Foot

Excavation, disposal of unsuitable Material, select backfill Material, placement and compaction of select backfill shall be included in the Bid Item Unit Price for each relevant pay item.

571.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the major items and will not be measured or paid for separately:

1. Submittals and design of Structures;
2. Longitudinal stiffeners;
3. Reinforcing ribs;
4. Installation and removal of shoring or ties to maintain shape;
5. On-site inspection by manufacturer's representative;
6. Repair of protective coating;
7. Coating of the Structures; and
8. Shallow or deep foundation elements.

DIVISION 600 – MISCELLANEOUS CONSTRUCTION

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SECTION 601: REMOVAL OF STRUCTURES AND OBSTRUCTIONS

601.1 DESCRIPTION

This Work consists of removing and salvaging, or disposing of buildings, fences, Structures, utility lines, pavement in its entirety or partially to neat cut or saw cut lines, and other obstructions.

This Work also includes salvaging specified Materials and backfilling the resulting trenches, holes, and pits.

The Contractor shall repair salvageable items that are damaged during removal, whether designated for removal in the Contract or by the Project Manager, at no additional cost to the Department.

601.2 MATERIALS—RESERVED

601.3 CONSTRUCTION REQUIREMENTS

601.3.1 General

If the Contract identifies Material for salvage, remove the Material and return to the Department in a transportable condition. The Contractor shall store this Material in accordance with the Contract.

The Contractor shall notify the Project Manager in writing of disposal details for Material not identified as salvage.

The Contractor shall destroy unusable, non-hazardous combustible Material. Dispose of non-hazardous, non-combustible Material. If the Contractor disposes of this Material outside the Right of Way, provide the Project Manager with a copy of the written permission from the property owner.

The Contractor shall backfill holes created by Structure removal. If the hole is within the Roadway Prism, compact in accordance with Section 203.3.5, "Embankments," and Section 203.3.7, "Moisture and Density Control." Break up concrete aprons or surfacing before burying to allow water to drain.

The Contractor shall provide a list of removals to the Project Manager at the preconstruction conference, with the following information for each:

1. A percent of the pay item amount; and
2. A monetary value.

601.3.2 Removal of Bridges, Culverts, and Other Drainage Structures

The Contractor shall remove existing Structures in a streambed down to the stream bottom. The Contractor shall remove existing Structures outside the stream to one (1) ft below the ground surface. The Contractor shall remove more of the existing Structure if necessary to accommodate a new Structure.

If dismantling a steel or wood Bridge, the Contractor shall minimize damage to the removed Material if identified as salvageable, match-mark the steel members (unless otherwise approved by the Project Manager), and store salvaged Material in accordance with Section 601.3.1, "Construction Requirements, General."

If removed concrete is specified for use as riprap in the Contract, the Contractor shall crush and stockpile as directed by the Project Manager.

601.3.3 Removal of Pipe

The Contractor shall minimize damage while removing existing pipe. If the Project Manager identifies existing pipe as reusable, the Contractor shall store the reusable pipe, minimizing loss or damage.

601.3.4 Removal of Pavement, Sidewalks, Curbs, and Gutters

The Contractor shall break asphalt pavement and concrete items including pavement, Sidewalks, curbs, and gutters, and dispose of them in accordance with Section 601.3.1, "Construction Requirements, General."

If approved by the Project Manager, the Contractor shall recycle existing ballast, Base Course, gravel; asphalt Material, and other surfacing Materials in accordance with Section 107.14.7, "Disposal of Removed Asphalt Pavement Material." The Contractor is responsible for disposing of excess Material in accordance with Section 601.3.1, "Construction Requirements, General."

601.3.5 Removal of Fence

The Contractor shall salvage fence Materials, unless otherwise specified in the Contract. The Contractor shall place barbed wire into single-strand rolls. The Contractor shall minimize damage when pulling posts.

601.3.6 Demolition

If the Contract requires demolition, the Contractor shall remove the existing Structures and restore to the existing surface.

Before beginning demolition, the Contractor shall coordinate disconnection of utility services with the appropriate utility owner.

The Contractor shall immediately repair broken or damaged utilities, at no additional cost to the Department.

601.3.7 Hauling and Stockpiling Salvageable Material

If the Contract requires the Contractor to haul and stockpile salvageable Material; the Contractor shall load, haul, unload, and stockpile the Materials in accordance with the Contract. The Contractor shall minimize damage to the Material.

The Contractor shall place the salvageable Material on blocks or other approved Materials and maintain the stockpile area, as directed by the Project Manager.

601.4 METHOD OF MEASUREMENT

The Department will measure Removal of Structures and Obstructions as a lump sum based on the schedule of values in the Contract.

601.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Removal of Structures and Obstructions</i>	Lump Sum
<i>Removal of Surfacing</i>	Lump Sum or Square Yard
<i>Demolition</i>	Lump Sum

The Department will make payment based on the percent complete of each item on the list of removals provided to the Project Manager at the Pre-Construction Conference.

The Department will not make additional payment for minor removals not specified in the Contract.

601.5.1 Work Included in Payment

The Department will consider the following Work as included in the payment and no separate payment will be made:

1. No direct payment will be made for filling cavities left by Structure removal, and the Work shall be considered Incidental to the applicable items;
2. No direct payment will be made for loading, hauling, unloading, and satisfactorily stockpiling salvageable Material and the Work shall be considered Incidental to the applicable items; and
3. Saw cutting when designated in the Contract.

SECTION 602: SLOPE AND EROSION PROTECTION STRUCTURES

602.1 DESCRIPTION

This Work consists of providing and placing riprap, gabions, revetment mattresses, sacked concrete revetment, concrete block revetment, wrapped rock faces, and other systems on the Embankment slopes and the sides and bottoms of channels, drain outlets, ditches, and other such locations.

602.2 MATERIALS

Unless otherwise specified in the Contract, the Contractor shall provide slope protection Structures as follows:

1. Hexagonal double-twisted wire mesh riprap, gabions, and revetment mattresses; or
2. Welded wire mesh gabions, revetment mattresses, and wrapped rock faces.

The Contractor shall provide galvanized slope protection items in accordance with ASTM A 641. If specified in the Contract, the Contractor shall coat galvanized items with PVC in accordance with Section 602.2.2.9, "PVC Coating."

The Contractor shall provide double-twisted riprap, gabions, and revetment mattresses in accordance with ASTM A 975. The Contractor shall provide welded wire mesh gabions, revetment mattresses, and wrapped rock faces in accordance with ASTM A 974.

602.2.1 Classifications

The Department will classify riprap and gabions in accordance with Table 602.2.1:1, "Riprap Classifications and Gabion Requirements."

The Contractor shall provide riprap with at least 80% of the stones meeting the specified size requirements. The Contractor shall use stones less than the minimum dimensions to fill voids. For riprap Class A, wrapped rock faces, and gabions, the Contractor shall not use stones smaller than the mesh openings.

The Department will classify riprap and gabions in accordance with Table 602.2.1:1 "Riprap Classifications and Gabion Requirements" with the exception of Class D, Derrick Stone. Class D, Derrick Stone will follow the gradation requirements in Table 602.2.1:2 "Gradation Requirements for Class D, Derrick Stone" shown below.

**Table 602.2.1:1
Riprap Classifications and Gabion Requirements**

Class	Description	Stone volume (ft ³)		Minimum dimension (in) ^a
		Minimum	Maximum	
A	Wire enclosed riprap	1/6	2/3	4
B ^b	Non-enclosed riprap	1	2	6
C ^b	Non-enclosed riprap	2	4	9
E	Grouted riprap	1/3	1	3
F	Grouted riprap	1	2	6
G	Rock plating	—	—	4–8 ^c

**Table 602.2.1:1
Riprap Classifications and Gabion Requirements**

Class	Description	Stone volume (ft ³)		Minimum dimension (in) ^a
		Minimum	Maximum	
N/A	Wrapped rockfacing	—	—	1
N/A	Gabions	—	—	4–8 ^c

^aMinimum size in the least dimension.

^bClass B and C stone — at least two (2) Fractured Faces.

^c70% to 80% of the stone — at least four (4) inches but not more than eight (8) inches in the smallest dimension. 30 to 20% of the stone — no larger than four (4) inches in any dimension.

**Table 602.2.1:2
Gradation Requirements for Class D, Derrick Stone**

Class, Description	Percent of Rock Equal or Smaller By Count, D _x	Range of Intermediate Dimension ¹ , (inches)	Range of Rock Weight ² , (pounds)
D, Derrick Stone ³	100	30	5000
	70	24 – 18	1780 – 2500
	40	11 – 14	360 – 500
	20	6 – 8	70 - 100

¹ Intermediate dimension measured as the shortest straight-line distance from one side of the rock or rock particle to the other on the maximum projection plane (plane of rock or rock particle with the largest projected surface area).
² Weights based on a specific gravity of 2.65.
³ Include spalls and rock fragments to provide a stable dense mass.

602.2.2 Riprap, Gabions, and Revetment Mattresses

602.2.2.1 Stone for Riprap, Gabions, Revetment Mattresses, and Rock Faces

Except for Class G riprap, the Contractor shall provide rocks or rough quarry stone with no more than 60% wear, in accordance with AASHTO T 96. The Contractor shall provide stone with a soundness loss of no more than 21, in accordance with AASHTO T 104 using a magnesium sulfate solution with a five (5)-cycle test duration.

The Contractor shall provide stone for riprap, gabions, revetment mattresses, and rockfaces in accordance with Section 602.2.1, "Classifications."

602.2.2.2 Wire Mesh

The Contractor shall provide non-raveling, double-twisted wire mesh forming hexagons for riprap, gabions, and revetment mattresses in accordance with Section 602.2.2.3, "Pull-Apart Test." The Contractor shall provide non-raveling welded wire mesh for gabions, wrapped rock faces, and revetment mattresses forming squares or rectangles in accordance with ASTM A 974, Section 7, *Material Properties*, except that the strength requirement for mattress joints is 900 lb per foot instead of 600 lb per foot.

602.2.2.2.1 Wire

The Contractor shall provide soft temper wire with a Class 3 zinc coating for constructing wire mesh in accordance with ASTM A 641. The Contractor shall provide 0.120-inch diameter wire for gabions and riprap and 0.087-inch diameter wire for revetment mattresses and wrapped rock faces.

602.2.2.2.2 Mesh Openings

The Contractor shall ensure that mesh openings are uniform and hexagonal. The Contractor shall make mesh openings for riprap and double-twisted gabions approximately 3 1/4 inch × 4 3/4 inch, and for double-twisted revetment mattresses approximately 2 1/2 inch × 3 1/4 inch. The Contractor shall make mesh openings for welded wire mesh gabions approximately three (3) inch × three (3) inch, and for welded wire mesh revetment mattresses and wrapped rock faces approximately 1 1/2 inch × three (3) inch.

602.2.2.2.3 Selvedges

The Contractor shall mechanically selvedge the edges of double-twisted gabions, revetment mattresses, and wrapped rock face, including, end panels and diaphragms. The Contractor shall use a selvedge wire with a diameter of at least 0.150 inch.

602.2.2.2.4 Lacing and Tie Wire

The Contractor shall provide lacing wire for double-twisted gabions, revetment mattresses, and wrapped rock faces with a diameter of at least 0.087 inch. The Contractor shall provide tie wire for double-twisted gabions and revetment mattresses with a diameter of at least 0.087 inch. The Contractor shall provide tie wire for riprap with a diameter of at least 0.120 inch. The Contractor shall provide lacing and tie wire with the same tensile strength and coating as the mesh wire.

602.2.2.2.5 Spiral Binders

The Contractor shall provide spiral binders for welded wire mesh gabions, revetment mattresses, and wrapped rock faces, of the same wire quality as the mesh wire with a diameter of at least 0.106 inch. Unless otherwise approved, the Contractor shall provide spiral binders with a maximum inside diameter of 2 1/2 inches and with a maximum pitch of three (3) inches.

602.2.2.2.6 Alternate Fasteners

The Contractor may use alternative fasteners, such as ring fasteners, with double-twisted wire mesh, and welded wire mesh riprap, gabions, revetment mattresses, and wrapped rock faces, if approved by the Project Manager. The Contractor shall provide wire for alternative fasteners in accordance with Section 602.2.2.2.5, "Spiral Binders."

602.2.2.2.7 Minimum Strength of Fasteners

The Contractor shall use fasteners that provide a minimum strength of 1,400 lb per foot for gabion baskets, and 900 lb per foot for revetment mattresses and wrapped rock faces.

602.2.2.2.8 Approval of Alternative Fasteners

The Contractor shall use a certified Laboratory to test alternative fasteners in accordance with Section 602.2.2.3, "Pull-Apart Test." At least 60 Days before using alternative fasteners, the Contractor shall submit CTRs to the Project Manager verifying that the fasteners meet the pull-apart test requirements.

The Contractor shall provide a description of the fastener, with drawings and photographs showing the number of fasteners required, details of the fasteners, and load capacities. In addition the Contractor shall:

1. Lock and close each interlocking fastener. For gabions, use fasteners in every other opening. For revetment mattresses and wrapped rock faces, use fasteners in every opening; and
2. Close each overlapping ring fastener and overlap ends a minimum of one (1) inch. Provide one (1) ring for each opening.

The Department will allow this fastener for forming individual baskets, but not for interconnecting baskets.

602.2.2.2.9 PVC Coating

The Contractor shall provide PVC coating with an average thickness of 0.0216 inch and a minimum thickness of 0.0150 inch per side. The Contractor shall apply PVC coating over the galvanizing.

The Contractor shall coat the galvanized wire with extruded or fusion bonded PVC Material. Unless otherwise specified, the Contractor shall use a gray or green colored coating. The Contractor shall use a PVC coating that meets the following requirements:

1. Specific gravity of from 1.20 to 1.40, if tested in accordance with ASTM D 792;
2. Abrasion resistance of less than 12% weight loss, if tested in accordance with ASTM D 1242-95A, Method B at 200 cycles, CSI-A Abrader Recording, 80 grit;
3. Brittleness temperature no higher than 15° F, if tested in accordance with ASTM D 746;
4. Tensile strength no less than 2,980 psi for extruded coating, if tested in accordance with ASTM D 412; and no less than 2,275 psi for fusion bonded coating, if tested in accordance with ASTM D 638;
5. Modulus of elasticity no less than 2,700 psi at 100% strain for extruded coating, if tested in accordance with ASTM D 412; and no less than 1,980 psi at 100% strain for fusion bonded coating, if tested in accordance with ASTM D 638;
6. Ultraviolet light exposure for a test period of no less than 3,000 h, using apparatus Type E at 145 °F, if tested in accordance with ASTM G 152; and
7. Salt spray test for a test period of no less than 3,000 h, if tested in accordance with ASTM B 117.

602.2.2.3 Pull-Apart Test

602.2.2.3.1 Sample Preparation

The Contractor shall prepare two (2) identical rectangular panels along a selvedge wire, each about 10 1/2 mesh-openings wide. The Contractor shall attach the two (2) panels along the two (2) selvedge wires using the proposed fastener system. If the Contractor uses alternative fasteners to join two (2) individual gabion baskets, the Contractor shall include two (2) additional selvedge wires (each mechanically wrapped with mesh wires) so that each fastener contains two (2) selvedges and two (2) mesh wires.

602.2.2.3.2 Test Procedures

The Contractor shall mount the joined test panels in a loading machine with grips or

clamps that secure the panels uniformly along the full width. The Contractor shall use grips or clamps designed to transmit only tension forces. The Contractor shall apply the load at a uniform rate of 50.7 lb per second until failure occurs. The Department will define failure as a drop in strength under continuous loading or, when an opening between two (2) joined selvedge wires exceeds two (2) inch. The minimum allowable strength at failure is 1,400 lb per foot for joined gabions; and 900 lb per foot for joined revetment mattresses and wrapped rock face panels.

602.2.2.4 Certification

The Contractor shall submit a certificate, to the Project Manager, stating that the following proposed items meet the requirements of this Specification before their use:

1. Wire mesh;
2. Gabion baskets;
3. Lacing wire;
4. Tie wire; and
5. Approved alternative fastener systems.

602.2.2.5 Stakes

The Contractor shall use steel railroad rails, standard weight galvanized steel pipe, or steel angles for riprap stakes. The Contractor shall use railroad rails with a unit weight of at least 30 lb per yard. The Contractor shall use standard weight galvanized steel pipe with a minimum outside diameter of four (4) inches. The Contractor shall use steel angles that are at least four (4) × four (4) × 3/8 inch.

602.2.2.6 Grout

The Contractor shall provide portland cement, aggregate, and water for grout in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.2.7 Material

The Contractor shall provide geotextile (filter fabric) Class one (1) as per Section 604, "Soil and Drainage Geotextiles."

602.2.3 Sacked Concrete Revetment

The Contractor shall provide sacked concrete revetment from a vendor on the Department's *Approved Products List*. The Contractor shall provide bags of concrete that weigh from 60 lb to 80 lb each, dry weight, and contain from 0.018 yd³ to 0.025 yd³ of concrete. The Contractor shall ensure each bag contains one (1) of the following mixes:

1. One (1) part cement to three (3) parts sand;
2. A mix design in accordance with the Contract; or
3. A mix design approved by the State Materials Bureau.

The Contractor shall provide a concrete mix capable of attaining a minimum compressive strength of 3,500 psi after 28 Days, unless otherwise specified in the Contract. The Contractor shall keep the sacked concrete in dry storage until application.

602.2.3.1 Packaging

The Contractor shall use permeable, biodegradable sacks made of jute, cotton, or scrim-reinforced paper that are capable of holding the sand-cement mix without significant leakage and allowing sufficient water to hydrate the concrete mix.

The Contractor shall provide non-asphaltic, three (3)-layer laminated, polyester-fiber-scrim-reinforced paper sacks. The Contractor shall perforate each of the three (3) layers and offset the perforations to prevent cement leakage.

The Contractor shall use only one (1) type and size of sack throughout the Project, unless otherwise specified in the Contract.

602.2.3.2 Portland Cement

The Contractor shall provide portland cement in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.3.3 Aggregate

The Contractor shall provide fine aggregate in accordance with Section 509, "Portland Cement Concrete Mix Designs."

602.2.3.4 Steel Anchorage

The Contractor shall provide steel staples in accordance with Section 540, "Steel Reinforcement." The Contractor shall use steel staples either epoxy coated in accordance with AASHTO M 284, or galvanized in accordance with ASTM A 153.

602.2.4 Concrete Block Revetment

The Contractor shall provide concrete block revetment products from the Department's *Approved Products List*. The Contractor shall provide concrete block units compatible with the geotextiles being used and with a minimum compressive strength of 3,000 psi, unless otherwise specified in the Contract.

602.3 CONSTRUCTION REQUIREMENTS

602.3.1 General Placement Requirements

The Contractor shall place riprap stones forming a continuous blanket in accordance with the Contract. Unless otherwise specified, the Contractor shall construct rock plating using riprap Class G to minimum thickness of 12 inches. The Contractor shall place stones with the long axis parallel to the toe of the slope, with a stable bearing upon the underlying soil or stones.

The Contractor shall place large stones as close together as possible. The Contractor shall use smaller stones to fill the areas between the larger stones, except when the Contract requires Class E or F (grouted) riprap.

The Contractor shall ensure that the finished riprap surface varies no more than three (3) inches from the specified slope; and derrick stone riprap varies no more than eight (8) inches from the specified slope.

Unless otherwise specified, the Contractor shall place the riprap foundation course in a trench excavated to 24 inches below the toe of the slope of the Embankment or side of channel.

The Contractor shall place a layer of Class 1 geotextile filter fabric between the slope and erosion protection Structures, and the backfill Material.

602.3.1.1 Grouted Riprap Placement

The Contractor shall fill riprap voids with grout to the full riprap thickness. After placing grout, the Contractor shall sweep the riprap surface with a stiff broom.

The Contractor shall protect grout from freezing for at least four (4) Days after placement.

The Contractor shall cure grouted riprap placed in hot, dry weather in accordance with Section 511.3.9, "Curing."

602.3.1.2 Proportioning and Mixing Grout

The Contractor shall use grout that consists of one (1) part portland cement and three (3) parts fine aggregate (by volume). The Contractor shall mix with water to a workable consistency.

602.3.1.3 Class A Riprap Placement

The Contractor shall enclose Class A riprap with wire mesh drawn tightly on all sides. The Contractor may connect wire mesh using approved fasteners or lacing wire. The Contractor shall weave adjacent edges at least once with double loops of lacing wire that is as strong and flexible as the mesh.

The Contractor shall provide continuous lacing as far as possible that passes through each mesh opening. Where splicing is necessary, the Contractor shall overlap the lacing at least 12 inches.

The Contractor shall space galvanized wire ties connecting top and bottom mesh layers approximately 24 inches on centers. The Contractor shall anchor the ties to the bottom wire-fabric layer. The Contractor shall extend the ties through the rock layer and secure to the top wire-fabric layer. The Contractor shall anchor wire-enclosed riprap to slopes with steel stakes driven into the Embankment. The Contractor shall space stakes in accordance with the Contract.

602.3.1.4 Placement of Geotextile

The Contractor shall place Class 1 non-woven geotextile (filter fabric) between the riprap or revetment mattresses and the supporting soil. The Contractor shall ensure that the fabric is in accordance with Section 604, "Soil and Drainage Geotextiles."

602.3.2 Sacked Concrete Revetment Placement

The Contractor shall place sacked concrete revetment within ± 0.2 ft of the specified grade and slope, or as directed by the Project Manager.

The Contractor shall place the foundation course in a trench excavated to 24 inches below the toe of the slope of the Embankment or side of channel. The Contractor shall stagger the sack ends and steel staple anchors of succeeding courses.

The Contractor shall tamp each row of sacks, round out the bags, eliminate wrinkles, minimize voids, and prepare an even surface for the next row.

The Contractor shall obtain the Project Manager's approval of the compaction method prior to backfill and compact soil behind each row of sacks before placing the next row. The Contractor shall not place large stones and jagged objects adjacent to the bags.

The Contractor shall anchor the sacks with steel staples without damaging the sacks.

After placing the sacks, the Contractor shall wet thoroughly and keep moist for at least three (3) Days.

602.3.3 Concrete Block Revetment Placement

The Contractor shall construct concrete block revetment systems in accordance with the manufacturer's recommendations and the Contract.

The Contractor shall remove slope obstructions, and fill voids with approved Material or grade slopes before placing concrete blocks.

602.3.4 Gabions

The Contractor shall supply gabions within \pm five percent (5%) of the manufacturer's stated sizes.

602.3.4.1 Assembly of Gabion Baskets

The Contractor shall fabricate gabions for individual assembly at the construction site.

If a gabion is greater than 1 1/2 times as long as it is wide, the Contractor shall divide the gabion into cells using diaphragms of the same wire mesh as the body of the gabion. The Contractor shall create cells that are no longer than the gabion is wide and anchor diaphragms to the base section of the gabion. The Contractor shall selvages or bind perimeter edges so the joints are as strong as the gabion body. The Contractor shall assemble perimeter edges using approved fasteners or lacing wire. The Contractor shall place fasteners in each mesh opening. The Contractor shall secure lacing wire by double looping through every other mesh opening. The Contractor shall assemble gabions using one (1) of the following:

1. Double looped lacing twice; or
2. Connect with approved fasteners and double looped lacing once.

602.3.4.2 Foundation Preparation

The Contractor shall level and compact the top six (6) in of the gabion foundation to at least 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), and to field densities in accordance with AASHTO T 310.

602.3.4.3 Placement of Gabion Baskets

The Contractor shall set assembled, empty baskets into the specified positions and wire each unit to adjacent units along the top and vertical edges before placing stone.

602.3.4.4 Placement of Gabion Stone

The Contractor shall place stone in equal layers of from nine (9) inch to 12 inch. The Contractor shall minimize local deformations by not filling a gabion more than 12 inches higher than an adjacent gabion. The Contractor shall hand place stone at exposed surfaces.

The Contractor shall provide cross-connecting wires on gabions with cells 18 inches or higher. The Contractor shall place cross connecting wires directly above each layer of stone. The Contractor shall equally space and tightly tie two (2) connecting wires in each direction for each layer through two (2) mesh openings at opposite faces of each gabion cell.

The Contractor shall maintain alignment while filling gabions (minimizing voids and bulges, and finishing to a neat square appearance).

After filling, the Contractor shall bend the lid over and tightly bind to the perimeters and diaphragms in accordance with Section 602.3.4.1, "Assembly of Gabion Baskets."

602.3.4.5 Gabion Marking

The Contractor shall mark each gabion in an identifiable manner that clearly indicates its size.

602.3.4.6 Placement of Geotextile

The Contractor shall install Class 1 non-woven geotextile (filter fabric) between gabion baskets and supporting soil, and between gabion baskets and backfill.

602.3.5 Placement of Wrapped Rock Faces

The Contractor shall place wrapped rock faces within ± 0.2 ft of the specified grade and slope.

The Contractor shall place the foundation course 18 inches below the toe of the slope of the Embankment or side of channel.

The Contractor shall place each level of welded wire forms with biaxial geogrid embedded in the rock face in accordance with the Contract, and tensioned with anchor pins to remove slack. The Contractor shall lap the geogrid a minimum of 12 inches at the edges of adjacent panels. The Contractor shall tamp the welded wire form face to eliminate wrinkles, minimize voids, and finish to an even surface.

The Contractor shall backfill and compact behind each welded wire form level before placing the next row. The Contractor shall obtain the Project Manager's approval of the compaction method.

602.4 METHOD OF MEASUREMENT

The Department will measure *Riprap Class*___ and *Sacked Concrete Revetment* based on the specified thickness and Accepted surface area.

The Department will measure *Concrete Block Revetment* and *Wrapped Rockfacing* based on the Accepted surface area.

The Department will measure *Gabions* and *Revetment Mattresses* based on the specified basket dimensions.

602.5 BASIS OF PAYMENT

Pay Item

Pay Unit

<i>Riprap Class ___</i>	Cubic Yard
<i>Riprap Class G</i>	Square Yard
<i>Sacked Concrete Revetment</i>	Cubic Yard
<i>Concrete Block Revetment</i>	Square Yard
<i>Gabions</i>	Cubic Yard
<i>Revetment Mattresses</i>	Cubic Yard
<i>Wrapped Rockfacing</i>	Square Yard

602.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Excavation, backfilling and disposal of Material required for the placement of slope and erosion protection Structures;
2. Dewatering; and
3. Stakes and steel staples, drainage geotextile(s).

SECTION 603: TEMPORARY EROSION AND SEDIMENT CONTROL

603.1 DESCRIPTION

This Work consists of preparing a Storm Water Pollution Prevention Plan (SWPPP), and constructing, inspecting, and maintaining erosion, sediment control, and storm water pollution prevention facilities for the discharge of storm water associated with construction activity. This Work includes construction phase activities through final stabilization.

The Contractor shall comply with requirements of Section 603, "Temporary Erosion and Sediment Control," and the requirements of NPDES, and if performing Work along or adjacent to live streams, the Contractor shall do so in accordance with the Federal Clean Water Act (33 USC 1251 et seq.), the regulations and requirements of other authorities with jurisdiction.

603.1.1 Storm Water Pollution Prevention Plan

The Storm Water Pollution Prevention Plan (SWPPP) must satisfy the requirements of the current Construction General Permit, applicable EPA municipal separate storm sewer system (MS-4 Permit) and must contain the following sections, forms, and information sheet:

SWPPP REQUIRED SECTIONS

1. Storm Water Team;
2. Nature of Construction Activities;
3. Emergency Related Projects (if applicable);
4. Identification of Other Site Operators;
5. Sequence and Estimated Dates of Construction Activities;
6. Site Map;
7. Construction Site Pollutants;
8. Non-Storm Water Discharges;
9. Buffer Documentation;
10. Temporary Erosion and Sediment Control Plan and Description of Storm Water Control Measures (Construction Phase & Final Stabilization);
11. Pollution Prevention Procedures;
12. Procedures for Inspection, Maintenance, and Corrective Action;
13. Staff Training;
14. Documentation of Compliance and Other Federal Requirements;
15. SWPPP Certification; and
16. Post-Authorization Additions to the SWPPP.

SWPPP REQUIRED FORMS

1. Notice of Intent (NOI);
2. Storm Water Program;
3. Storm Water Management;
4. NPDES *General Construction Storm Water Permit Checklist*; and
5. Contractor Certification for NPDES *General Permit for Storm Water Discharges from Construction Sites*.

An information sheet provided by the NMDOT provides the following:

1. A site description;
2. NOI inputs;
3. Drainage parameters;
4. Runoff, discharge, and volume calculations; and
5. General notes.

The information sheet is included in the Plans. For more information on SWPPP, see Section 603.1.1.2, "Department Responsibilities." The NPDES Construction General Permit, issued by the EPA, requires a SWPPP and submittal of the NOI for construction Projects with one (1) acre or more of earth disturbance as defined in the NPDES Construction General Permit.

603.1.1.1 Final Erosion and Sediment Control Plan

The Final Stabilization Temporary Erosion and Sediment Control Plan (TESCP) prepared by the Department depicts the location, type, and length of temporary erosion control measures, off-site flows, discharge locations, and flow paths within the Right of Way on plan sheets at final placement prior to seeding operations. For more details on the Final Stabilization TESCP, see Section 603.1.1.2, "Department Responsibilities."

The Construction Phase Temporary Erosion and Sediment Control Plan (TESCP) prepared by the Contractor depicts the location, type, and length of temporary erosion control measures, off-site flows, discharge locations, and flow paths within the Work area of the Right of Way on construction phasing plan sheets. For more details on the Construction Phasing TESCP, see Section 603.1.1.3, "Contractor Responsibilities."

603.1.1.2 Department Responsibilities

The Department will prepare and include in the Plans a Final Stabilization TESCP, a Re-vegetation/Erosion Control Plan, and a SWPPP information sheet. The Final Stabilization TESCP sheets will include the following:

1. Site maps;
2. Drainage patterns;
3. Discharge locations;
4. Approximate slopes;
5. Areas of soil disturbance;
6. Major controls locations;
7. Structural practices;
8. Surface waters (including wetlands);
9. Conditions before and after construction;
10. Right of Way lines;
11. Easements;
12. Existing and new Structures;
13. Existing and proposed Roadway grades; and
14. Detours outside of the Right of Way.

The Re-vegetation/Erosion Control Plan sheet will provide a description and timing of final stabilization practices.

The SWPPP information sheet will include the following information:

1. Nature of the activity;
2. Total site area;
3. Total disturbed area;
4. Runoff coefficient for pre/post construction;
5. Receiving waters;
6. Latitude and longitude of the site;
7. Estimate of likelihood of discharge;
8. Endangered species or critical habitat;
9. Part 3 of the NPDES General Permit, Water Quality-Based Effluent Limitations;
10. Basic drainage and site information required for SWPPP development;
11. MS4 areas; and
12. 303d impaired list.

603.1.1.3 Contractor Responsibilities

Before disturbing any soil, the Contractor shall prepare and submit to the Project Manager a Contractor developed SWPPP based on the planned construction phasing and schedule. The Contractor shall prepare amendments to the SWPPP as Work progresses or as phasing or scheduling changes are made. Specifically, the Contractor shall prepare a Construction Phase TESC stamped by a Professional Engineer for each construction phase, complying with provisions of the NPDES Construction General Permit, and include at least the following items or activities:

1. Develop the SWPPP using a combination of structural, non-structural, and vegetative best management practices (BMPs) appropriate for the identified location to control erosion and sedimentation and manage storm water during construction activities;
2. Include proposed methods for minimizing or eliminating pollution of streams, lakes, reservoirs, canals, and other water impoundments from storm water discharge associated with construction activities;
3. Do not start earth—disturbing activities until the Contractor developed SWPPP has been submitted and the NOI is active;
4. Refer to the recommendations in the current version of the Department's National Pollutant Discharge Elimination System Manual: Storm Water Management Guidelines for Construction and Industrial Activities;
5. Provide a signed, certified statement that states the terms and conditions of the NPDES General Permit are fully understood. Include a statement of intent to fully implement the SWPPP as proposed or modified at the pre-construction meeting in the certification; and
6. Maintain the SWPPP in accordance with the NPDES Construction General Permit until final grading, erosion control, and seeding operation completion.

603.1.2 Retention of Records

The Contractor shall retain and maintain SWPPP changes as required by the NPDES General Permit. The Contractor shall include copies of the permit language and inspection and maintenance reports in the SWPPP. The Contractor shall prepare inspection and maintenance reports from commencement of earthwork activities to Project completion. The Contractor shall deliver the SWPPP to the Project Manager at Project completion. The

Contractor shall ensure that these records are available to the public at all times.

603.1.3 Notice of Intent (NOI)

The Contractor shall provide a copy of the electronic NOI (eNOI) to the Project Manager that meets the NPDES General Permit requirements for discharge of storm water associated with construction activities.

The Department and the Contractor will prepare and submit separate eNOIs to the EPA, designating the status of owner/operator. The Contractor shall not begin earth-disturbing activities until the eNOIs are listed on the EPA website as "active." The EPA will post eNOI approvals on their website. The Contractor shall submit a copy of the Contractor's eNOI to the Project Manager.

603.1.4 Notice to Termination (NOT)

The Contractor shall prepare and submit a NOT to the EPA within 30 Days after Project completion, indicating that the operator of the Project has changed to the NMDOT. The Contractor shall provide a copy of the submittal to the Project Manager.

603.1.5 Off-Site Pollution Prevention Plan

The Contractor shall prepare and submit a SWPPP, eNOI, and NOT, if required, to appropriate agencies for Work performed outside the Project Right of Way. The Contractor is responsible for all associated NPDES requirements for the off-site locations. The Contractor shall comply with NPDES requirements for off-site locations. The Contractor shall provide a copy of each off-site submittal to the Project Manager.

603.1.6 Liquidated Damages

Failure to comply with the NPDES program may result in EPA citations.

If the Contractor does any of the following, the Department will assess liquidated damages in accordance with Table 603.1.6:1, "Liquidated Damages Schedule:"

1. Fails to maintain temporary erosion control measures in accordance with Section 603.3.6, "Erosion Control Inspection and Maintenance;"
2. Fails to document inspection and maintenance activities (as required by the General Permit); or
3. Fails to document, in a Corrective Action Report (as required by the General Permit), field changes of erosion control measures as directed in writing by the Project Manager.

**Table 603.1.6:1
Schedule of Liquidated Damages**

Total Original Contract Amount (\$)	Charge (\$) per Day
≤2,000,000	500
>2,000,000–5,000,000	1,000
>5,000,000–10,000,000	1,500
>10,000,000	2,000

The Project Manager will keep a schedule of noncompliance that the Department will use to calculate liquidated damages. The Department will assess liquidated damages until the

Project Manager issues a written notice of compliance to the Contractor.

If the Contractor's failure to adhere to the NPDES General Permit requirements results in a fine assessed against the Department, the Contractor shall reimburse the Department within ten (10) Days of the assessment. If the Contractor does not reimburse the Department within the ten (10) Days, the Department may pay the fine assessed and withhold the fine amount from the Contractor's next partial payment.

603.2 MATERIALS

603.2.1 General

The Contractor shall provide Materials for erosion, sediment control, and storm water pollution prevention measures that consist of siltation fences, socks, rock, riprap, soil retention blankets, or other Acceptable measures approved by the Project Manager.

603.2.2 Slope Drains

The Contractor shall provide Materials for slope drains that consist of pipe, flexible pipe, and riprap. The Project Manager may approve the use of other Materials.

603.2.2.1 Pipe

See Section 570, "Pipe Culverts" for approved types of pipe.

603.2.3 Geotextiles

603.2.3.1 Drainage Geotextiles

The Contractor shall provide drainage geotextiles (Class B drainage applications) for silt fence in accordance with Section 604, "Soil and Drainage Geotextiles," unless otherwise specified in the Contract.

603.2.3.2 Soil Retention Blanket

The Contractor shall provide a soil retention blanket from the Department's *Approved Products List*, or as specified in the Contract and approved by the Project Manager.

603.2.4 Riprap

The Contractor shall provide riprap and rock plating in accordance with Section 602, "Slope and Erosion Protection Structures."

603.2.5 Temporary Soil Stabilant

The Contractor shall provide a temporary soil stabilant from the Department's *Approved Products List*, or as specified in the Contract and approved by the Project Manager.

The Contractor shall ensure that the soil stabilant contains an anti-foaming agent and color additive to assist in its uniform application and disappears from the surface within 36 hours after application.

603.2.6 Composted Mulch Socks

The Contractor shall core Material (Composted Mulch): See Section 632, "Revegetation"

for composted mulch Specifications. The core Material shall be 100% composted mulch as per Section 632, "Revegetation."

Containment Mesh: The Contractor shall furnish containment mesh 100% biodegradable, photodegradable such as burlap, twine, UV photodegradable plastic, polyester, or other Acceptable Material as directed by the Project Manager.

The mesh should not exceed 3/8 inch in diameter.

The Contractor shall furnish biodegradable or photodegradable containment mesh when the socks will remain in place as part of the permanent or temporary vegetative Plan. The containment mesh shall be greater than nine (9) inches in height after being packed. The containment mesh shall be densely packed so that the socks do not deform.

603.3 CONSTRUCTION REQUIREMENTS

603.3.1 General

The Contractor shall apply appropriate erosion and sediment control measures for construction activities per the Accepted Contractor developed SWPPP.

The Contractor shall install temporary erosion and sediment control features and maintain until final grading, erosion control, and seeding operations completion.

The Contractor shall incorporate permanent erosion and sediment control measures, such as riprap pads or other forms of energy dissipaters at the outlets of Structures, into the Project at the earliest practical time, as directed by the Project Manager.

603.3.2 Contractor's Operations

The Contractor shall keep construction activity to a minimum within the Project Right of Way, adjacent to the Project, to prevent damage to vegetation. The Contractor shall repair damage or disturbance to areas, not necessary for construction of the Project, at no additional cost to the Department.

The Contractor shall keep construction areas in an orderly condition and promptly dispose of refuse and discarded Materials.

As directed by the Project Manager, the Contractor shall provide erosion and sediment control measures necessary to correct negligent or improper installation, at no additional cost to the Department.

603.3.2.1 Sequence of Operations

Before Work begins, the Project Manager and the Contractor will conduct a site inspection to review the planned erosion control protections. The Contractor shall use the Contractor developed SWPPP for this review.

The Contractor shall coordinate the placement and maintenance of the temporary and permanent erosion and sediment control measures shown in the Contractor developed SWPPP.

The Department will assess liquidated damages, in accordance with Section 603.1.6, "Liquidated Damages," if the Contractor begins earth-disturbing Work before the following:

1. Submission of the eNOI and obtaining notification of permit coverage; or
2. Placing erosion control measures.

603.3.2.2 Watercourse Protection

The Contractor shall provide filtration or settling basins to treat water used to wash aggregate or water used for similar operations.

The Contractor shall locate and construct waste disposal areas and haul Roads to prevent sediment from entering streams and water impoundment areas, or leaving the Project.

The Contractor shall not operate mechanized Equipment in perennial streams, unless otherwise specified in the Contract.

The Contractor shall use temporary Bridges or other crossing Structures constructed of non-erodible Material, where frequent stream crossings are necessary.

The Contractor shall clear false Work, piling, debris, and other obstructions placed during construction from streambeds, arroyos, and watercourses as soon as possible. The Contractor shall not allow waste from haul truck cleaning to drain into watercourses.

The Contractor shall provide the necessary buffer protection for adjacent surface waters as required by the General Permit.

603.3.3 Temporary Soil Stabilant Application

The Contractor shall apply temporary soil stabilant to exposed areas not being worked. The Contractor shall begin stabilization within one (1) Work Day after Work ceases, unless construction resumes within 14 Days after Work ceases.

The Contractor shall follow the manufacturer's recommendations for storage and application of the soil stabilant. The Contractor shall maintain the rate of application recommended by the manufacturer. If the soil stabilant does not produce the required results; the Project Manager and the Department's Landscape Architect may modify the manufacturer's application rate.

The Contractor shall reapply stabilant to areas of continued erosion and Contractor activity within four (4) weeks after the initial application at no additional cost to the Department, as directed by the Project Manager.

603.3.4 Composted Mulch Socks

The Contractor shall install the socks near the downstream perimeter of the disturbed area as shown on the final SWPPP to intercept sediment from sheet flow or as inlet protection as directed by the Project Manager. Close contact between the earth and sock should be maintained by removing remaining vegetation, rocks, debris, and dirt clods. The socks will be interlocked or overlapped at the ends.

Anchoring should be adequate to prevent displacement during design rain events and to prevent flow under the socks. The anchors will be two (2) inch by two (2) inch wooden stakes, APL product, or as approved by the Project Manager. Wooden stakes shall be placed at ten (10) ft maximum spacing on all flat areas and four (4) ft maximum spacing on slopes to prevent the sock from sagging. Stakes shall be driven in the ground 12 inches' with four (4) inches extending out of sock.

603.3.5 Earthwork Operations

The Contractor shall protect slopes as excavation or Embankment construction progresses.

The Contractor shall maintain and protect the earthwork in Roadway sections through all construction stages to prevent sediment from leaving the construction limits.

The Contractor shall provide temporary slope drain facilities that can collect runoff and carry it to the slope bottoms. The Contractor shall use drain Materials capable of length change as earthwork operations progress.

603.3.6 SWPPP Inspection and Maintenance

The Contractor shall inspect and maintain the Project site for NPDES compliance during the Project. The Contractor shall inspect and maintain installations at the following frequencies, per the General Permit:

1. At least once every seven (7) Calendar Days; or
2. Once every 14 Calendar Days and within 24 hours of a 0.25 inch or greater rainfall event; or
3. For Arid, Semi-Arid, or Drought-Stricken Areas. The Contractor may reduce the frequency of inspections to once per month and within 24 hours of the occurrence of a storm event of 0.25 inches or greater if your site is located in an arid, semi-arid, or drought-stricken area, as these terms are defined in Appendix A of the Construction General Permit, and construction is occurring during the seasonally dry period or during a period in which drought is predicted to occur. The Contractor must document that they are using this reduced schedule and the beginning and ending dates of the seasonally dry period in the SWPPP.

Maintenance Work includes, but is not limited to, repair of damaged installations, removal of trapped sediment, and cleaning of any silt fence. The Contractor shall remove accumulated silt when the control installation becomes 50% filled. The Contractor shall inspect disturbed areas, Material storage areas, discharge locations, and structural control measures. The Contractor shall inspect vehicle entrances and exits for Material being tracked off-site. The Contractor shall document each inspection on the *SWPPP Inspection Form* provided by the Department. The Contractor shall submit the inspection report signed by a NPDES-trained and qualified person to the Project Manager within 24 hours after the inspection. The Contractor shall include copies in the Contractor's SWPPP.

The Contractor shall install a rain gauge at the Project site to track rainfall amounts for the inspection schedule.

The Contractor shall designate the person responsible for the SWPPP on the qualification form provided by the Department, and sign. The Contractor shall ensure that the person is familiar with the Project SWPPP and document the responsible person's experience and training on the qualification form. The Contractor shall include it with the SWPPP. The Project Manager will assign a qualified Department representative (with qualification form) experienced and trained in implementing BMPs.

The Contractor shall repair damaged erosion and sediment control installations within three (3) Days of an inspection or following notification by the Project Manager that repairs are required.

If a damaged erosion control installation could result in sediment discharge into a live stream, water impoundment, or other body of water, the Contractor shall initiate repairs within 24 hours or sooner, as necessary or as directed by the Project Manager.

The Contractor shall maintain erosion and sediment control installations specified to remain following completion of the Work until the Project is completed.

The Contractor shall dispose of erosion and sediment control installations in accordance with the Contract or as directed by the Project Manager.

603.3.7 Removal of Control Installations

The Contractor shall remove temporary erosion and sediment control installations and features from the Project area when no longer required, unless otherwise specified in the Contract or directed by the Project Manager. After removing temporary erosion control installations, the Contractor shall restore ground lines, cover, and features as closely as possible to original condition.

Removed sediment may be deposited at locations within the Right of Way, if approved by the Project Manager. Where removed sediment is deposited in previously undisturbed areas, the Contractor shall reseed those areas at no additional cost to the Department.

603.4 METHOD OF MEASUREMENT

The Department will measure check dams along the crest of the dam.

603.4.1 SWPPP Plan Preparation and Maintenance

The Department will reimburse the cost to prepare the SWPPP, prepare and install all BMPs for the Construction Phase TESCP, and maintain the Construction Phase TESCP BMPs under pay item SWPPP Plan Preparation and Maintenance.

603.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Silt Fence</i>	Linear Foot
<i>Check Dam Type _____</i>	Linear Foot
<i>Earth Dike</i>	Linear Foot
<i>Pipe Slope Drain</i>	Linear Foot
<i>Sediment Trap</i>	Cubic Yard
<i>Soil Retention Blanket</i>	Square Yard
<i>Temporary Soil Stabilant</i>	Acre
<i>Culvert Protection</i>	Square Yard
<i>Drop Inlet Protection Type _____</i>	Each
<i>SWPPP Plan Preparation and Maintenance</i>	Lump Sum
<i>Composted Mulch Socks</i>	Linear Foot

SWPPP Plan Preparation and Maintenance includes SWPPP preparation, BMPs, installation of BMPs, inspection, and maintenance of erosion and sediment control measures, preparation of inspection reports, updating and/or modifying, maintaining, and retaining the SWPPP and other related records.

603.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the above item(s) and will not be measured or paid for separately:

1. Cleaning and maintenance of the temporary erosion and sediment control measures;
2. Posts, hardware, and appurtenances of the temporary erosion and sediment control measures;
3. Riprap for pipe slope drains and sediment traps;
4. Excavation and disposal of sediment deposits;
5. Removal and disposal of temporary erosion and sediment control measures, if required;
6. Subsequent applications of temporary soil stabilant due to unsatisfactory results;
7. Removal and replacement of the measure at the same location due to construction; and
8. Relocation of BMPs during phasing and final placement.

603.5.2 Partial Payments

The Department will make an initial partial payment for *SWPPP Plan Preparation and Maintenance* upon receipt and Acceptance of the Contractor SWPPP based on the following equation:

$$P_1 = L \times 0.20 \tag{1}$$

Where,

P_1 is the initial partial payment upon receipt and approval of Contractor SWPPP.

The Department will make monthly partial payments for *SWPPP Plan Preparation and Maintenance* based on the rate of progress of the Project, less previous partial payments for this item. The Department will calculate partial payments in accordance with the following equation:

$$P_2 = [(A \times L)/B] - C \tag{2}$$

Where,

- P_2 is the partial payment during the progress of the Project
- L is the Total Bid Amount for *SWPPP Plan Preparation and Maintenance*
- A is the number of Days charged the Contractor toward completion of the Project
- B is the Contract Time
- C is the total amount of previous partial payments for this item.

SECTION 604: SOIL AND DRAINAGE GEOTEXTILES

604.1 DESCRIPTION

This Work consists of providing and installing geotextiles.

604.2 MATERIALS – RESERVED

604.2.1 Classifications

The Contractor shall use the class of geotextile in accordance with Table 604.2.1:1, "Cross Reference of Old Classes to New Classes of Geotextiles."

**Table 604.2.1:1
Cross Reference of Old Classes to New Classes of Geotextiles**

Geotextile	Old class	New class
Subsurface drainage	A or B	2 or 3
Sediment control	B	2
Erosion control	C or D	1 or 2
Separation	C or D	2 or 3
Stabilization	None	1

The Department specifies Class 1 for more severe or harsh installation conditions where there is a great potential for geotextile damage and specifies Class 2 and 3 for less severe conditions.

604.2.2 Subsurface Drainage Geotextiles

The Department prohibits the use of woven slit film geotextiles or geotextiles made from yarns of a flat, recording-like character.

The Contractor shall provide Class 2 geotextiles for drain system installations that require use of very coarse, sharp angular aggregate with a one (1) inch diameter or greater, or require a depth of trench greater than six (6) ft.

The Contractor shall provide Class 3 geotextiles for general underdrain installations that require smooth graded surfaces having no sharp angular projections and fine aggregate.

604.2.3 Erosion Control Geotextiles

The Department prohibits the use of woven slit film geotextiles or geotextiles made from yarns of a flat recording-like character. If the Contractor uses a woven monofilament geotextile, the Contractor shall provide a Class 2 geotextile; otherwise the Contractor shall provide a Class 1 geotextile.

604.2.4 Separation Geotextiles

The Contractor shall provide separation geotextiles that are of woven or non-woven Material.

The Contractor shall use a Class 2 separator for Pavement Structures constructed over soils with an R-value greater than 20 to separate dissimilar Materials where water seepage is

allowable. The Contractor shall use Class 2 geotextiles where installation requires a depth of trench greater than ten (10) ft, where stone drop height is to be more than zero (0), or where there is no sand cushion protection. The Department requires field trials where stone drop height exceeds three (3) ft or where individual stone weight exceeds 250 lb.

The Contractor shall use Class 3 geotextiles to prevent mixing of a Subgrade soil and an aggregate cover Material (Subbase, base, select Embankment, etc.), to separate dissimilar Materials where water seepage is allowable. The Contractor shall not use Class 3 geotextiles under pavement. The Contractor may also use Class 3 geotextiles in Structures or under conditions where the geotextile is protected by a sand cushion or by "zero (0) drop height" placement of stone.

The Contractor shall use Table 604.2.4:1, "Required Class of Separator Geotextile and Cover Thickness for R-values Greater Than or Equal to 20," to determine the class of separator geotextile and the required minimum thickness.

**Table 604.2.4:1
Required Class of Separator Geotextile and Cover Thickness for R-values Greater Than or Equal to 20**

Required minimum cover thickness, compacted	Required class of geotextile
6 inch.	2
12 inch.	3

The Contractor shall not use aggregate larger than one (1) inch.

604.2.5 Stabilization Geotextiles

The Contractor shall provide stabilization geotextile in wet, saturated conditions to provide separation, filtration, and also reinforcement. The Contractor shall use stabilization geotextiles for Pavement Structures constructed over soils with R-values from ten (10) to 20. The Contractor may provide stabilization geotextiles made of woven or non-woven Material.

The Contractor may use stabilization geotextiles in applications that require a design by a licensed professional Engineer. The Contractor shall obtain Department approval of these designs.

604.2.6 Certification

For each class of geotextile fabric, the Contractor shall provide a certificate from the manufacturer stating that the geotextile meets the physical and chemical requirements in accordance with AASHTO M 288, and that geotextile fabric meets R-value requirements for the respective application.

The Contractor shall include in the certification the product name, chemical composition of the filaments or yarns, or other relevant information to fully describe the geotextile.

The Contractor shall submit the certification to the Project Manager before geotextile placement.

R-values corresponding to California bearing ratio (CBR) used in AASHTO M 288 are presented in Table 604.2.6:1, "CBR Values Used in AASHTO M 288 and Corresponding R-values."

**Table 604.2.6:1
CBR Values Used in AASHTO M 288 and Corresponding R-values**

Soil strength (CBR)	Corresponding R-value
1	10
2	15
3	20

604.3 CONSTRUCTION REQUIREMENTS

604.3.1 Geotextile Packaging, Storage, and Handling

The Contractor shall use geotextile rolls wrapped with a Material to protect the geotextile, including the ends of the roll, from damage.

The Contractor shall cover and elevate geotextile rolls during storage to protect them from the following:

1. Site construction damage (tearing, excessive mud, wet cement, or epoxy);
2. Precipitation;
3. Extended ultraviolet radiation including direct sunlight;
4. Chemicals that are strong acids or strong bases;
5. Flames including welding sparks; and
6. Temperatures above 160 °F and below -22 °F.

604.3.2 Geotextile Exposure After Placement

The Contractor shall not expose geotextiles to the elements after placement for more than 14 Days, unless otherwise directed by the Project Manager.

604.3.3 Site Preparation

The Contractor shall prepare the installation site by clearing and grading the area and preparing a firm, smooth surface on which to place the geotextiles. The Contractor shall remove sharp objects and large stones and cut trees and shrubs flush with the smooth surface.

The Contractor shall ensure correct orientation (roll direction). The Contractor shall place geotextiles as smoothly as possible on the prepared surface; pull tight, align, and anchor such that the geotextile is free of wrinkles and does not show evidence of holes, tears, or rips before placing cover Material on the geotextile. Before placing cover Material, the Contractor shall hold geotextiles in place by pins, staples, or piles of fill or rock as required by fill placement procedures. On curves, the Contractor shall fold or cut geotextiles to conform to the curve.

The Department will not allow vehicles directly on the geotextile, but will allow vehicles after the Contractor places at least six (6) inches of cover Material on the geotextile. The Contractor shall not allow vehicles to turn on the cover Material until at least two (2) lifts of cover Material have been placed.

604.3.4 Backfill

The Contractor shall obtain approval from the Project Manager before beginning backfill operations. The Contractor shall not end dump backfill directly onto exposed geotextile. The

Contractor shall backfill by end dumping onto previously spread backfill and then pushing the dumped backfill over the exposed geotextile. On Subgrades having an R-value less than ten (10), the Contractor shall dump and spread the Material placed on the geotextile to minimize the potential of a localized Subgrade failure.

The Contractor shall backfill in layers from six (6) inches to eight (8) inches deep (uncompacted) unless otherwise specified in the Contract. After placement, the Contractor shall compact each lift to 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Contractor shall compact the top lift in accordance with Section 207, "Subgrade Preparation." The Contractor may use vibratory compaction Equipment on initial layers of Material, if approved by the Project Manager.

The Contractor shall repair ruts occurring during construction by filling with additional Material and compacting to the specified density to maintain an even backfill surface and the minimum lift thickness over the geotextile.

The Contractor shall obtain the Project Manager's approval of geotextile placement before covering.

604.3.5 Subsurface Drainage Geotextiles

The Contractor shall place geotextiles in accordance with Section 605, "Drains," where specified.

The Contractor shall use subsurface drainage geotextiles against soil in an underground drainage system or in an edgedrain to allow for long-term passage of water into a subsurface drain system while retaining the in-situ soil. The primary function of the geotextile in subsurface drainage applications is filtration.

The Contractor shall provide one (1) soil sample to the Department for testing to confirm the applicable apparent opening size based on the percent of in-situ soil passing the No. 200 sieve and cohesiveness (PI).

The Contractor shall compact the aggregate with vibratory Equipment to a minimum compaction of 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). If a higher compactive effort is necessary, the Contractor shall substitute a geotextile suited for more severe installation conditions.

604.3.6 Sediment Control Geotextiles

The Contractor shall place geotextiles in accordance with Section 603, "Temporary Erosion and Sediment Control," where necessary.

The Contractor shall place and maintain sediment control geotextiles as a temporary control measure to prevent eroded soil from being transported off the construction site to rivers, streams, and impoundments and to prevent damage to private property from storm water runoff.

604.3.7 Erosion Control Geotextiles

The Contractor shall place geotextiles in accordance with Section 602, "Slope and Erosion Protection Structures," where necessary.

The Contractor shall use erosion control geotextiles between erosion control Structures (rip-rap and gabions) and the in-situ soil to prevent soil loss resulting in excessive scour and to

mitigate hydraulic uplift pressures that may cause instability of an erosion control Structure.

604.3.8 Separation/Stabilization Geotextiles

The Contractor shall use separation/stabilization geotextiles as a semi-permeable separator to prevent mixing of a Subgrade soil and sub-base or base Material.

The Contractor shall fold, overlap, sew, or join adjacent geotextile rolls in accordance with Table 604.3.8:1, "Minimum Overlap Requirements for Separation/Stabilization Geotextiles," unless manufacturer's recommendations or the Contract are more stringent.

**Table 604.3.8:1
Minimum Overlap Requirements for Separation/Stabilization Geotextiles**

Soil strength R-value	Un-sewn seams overlap (inch)	Sewn seams overlap (inch)
<10	—	9
10–15	40	8
15–20	30	3
>20	24	—

The Contractor shall ensure that both factory and field sewn or sealed seams meet or exceed the strength requirements as required by the manufacturer.

604.3.9 Repair of Damaged Geotextiles

To repair subsurface drainage, erosion control, and sediment control geotextiles, the Contractor shall clear the damaged area and repair in accordance with the manufacturer's recommendations. The Contractor shall obtain the Project Manager's approval of repairs.

To repair separation/stabilization geotextiles, the Contractor shall clear the damaged area plus an additional three (3) ft around the damaged area and repair in accordance with Table 604.3.8:1, "Minimum Overlap Requirements for Separation/Stabilization Geotextiles," unless manufacturer's recommendations or the Contract are more stringent. The Contractor shall replace removed cover Material and compact to the specified density.

604.4 METHOD OF MEASUREMENT

The Department will only measure the area of one (1) layer at geotextile overlaps.

604.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Geotextile Class</i>	Square Yard

Payment for achieving Subgrade preparation in accordance with Section 207, "Subgrade Preparation" will be paid as Subgrade Preparation.

604.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Repair of damaged geotextile fabric as a result of the Contractor's negligence, improper shipping, handling, packaging, or storing;

2. Geotextile packaging, storage and handling; and
3. Overlaps, anchoring, splicing and seam assemblies.

SECTION 605: DRAINS

605.1 DESCRIPTION

This Work consists of constructing underdrains, french drains, vertical drains, and drain outlets.

605.1.1 Definitions

Drain Outlet Lateral. A Drain Outlet Lateral is a non-perforated pipe placed in an unlined, backfilled trench.

French Drain. A French Drain is a non-vertical, rectangular, prism-shaped, subterranean water-collector drainage system consisting of open-graded granular Material wrapped in geotextile fabric ("drainage blanket") and a perforated collector pipe at the drainage blanket's lowest elevation.

Underdrain. An Underdrain is a collector drainage system typically located under pavement sections. An Underdrain system consists of a perforated collector pipe placed in a geotextile-lined, shallow, narrow trench that is then backfilled with untreated, open-graded Base Course.

Vertical Drain. A Vertical Drain is a vertical, rectangular, prism-shaped, subterranean, water-collector drainage system consisting of open-graded granular Material wrapped in geotextile fabric.

605.2 MATERIALS

605.2.1 Pipe

605.2.1.1 Polyvinyl Chloride Pipe

The Contractor shall provide PVC pipe in accordance with the following:

1. ASTM D 1785;
2. ASTM D 2464;
3. ASTM D 2467; and
4. ASTM D 2564.

The Contractor shall provide perforations and slots in accordance with AASHTO M 175, except provide perforations with a diameter of 0.19 in, unless otherwise specified in the Contract.

605.2.1.2 Polyethylene Pipe

The Contractor shall provide polyethylene pipe in accordance with AASHTO M 252, AASHTO M 294, and ASTM D 3350.

605.2.1.3 Metal Pipe

The Contractor shall provide metal pipe in accordance with Section 570, "Pipe Culverts."

605.2.2 Drainage Geotextiles

The Contractor shall provide drainage geotextiles for Underdrains in accordance with

Section 604, "Soil and Drainage Geotextiles."

605.2.3 Granular Materials

The Contractor shall provide granular backfill in accordance with Section 303, "Base Course," for open graded Base Course, or as specified in the Contract.

605.2.4 Hardware Screen

The Contractor shall provide galvanized steel or stainless steel hardware screen for drain outlets with one (1) inch nominal mesh openings. The Contractor shall provide galvanized connecting hardware.

605.2.5 Precast Headwall

The Contractor shall provide precast headwall with hardware screen as per Contract.

605.3 CONSTRUCTION REQUIREMENTS

605.3.1 Placement of Drainage Geotextiles

The Contractor shall place drainage geotextiles in accordance with Section 604, "Soil and Drainage Geotextiles."

The Contractor shall connect and maintain overlaps of geotextiles so that the drainage geotextile covers the drain for the entire length and has no breaks or holes.

605.3.2 Placement of Pipe

The Contractor shall place perforated pipe with the perforations down, unless otherwise specified in the Contract. The Contractor shall join pipe sections securely with the appropriate couplings, fittings, or bands as recommended by the manufacturer for the specific application.

The Contractor shall place non-perforated pipe with the bell-end upgrade. The Contractor shall close upgrade ends with concrete plugs to prevent entry of soil Materials.

605.3.3 Placement of Open-Graded Backfill

After the Department inspects and approves the pipe installation, the Contractor shall place granular Material in layers no more than 12 inches thick and compact after placement of each layer with a steelwheeled, self-propelled roller that will provide good consolidation without excessive breakage of the aggregate, to the satisfaction of the Project Manager. The Contractor shall not displace pipe or geotextile.

605.3.4 Placement of Impermeable Material

If the Contract requires the Contractor to place an impermeable Material around the drain system, the Project Manager must approve the Material.

The Contractor shall place the impermeable Material in no more than six (6) inch layers of loose thickness. The Contractor shall compact each layer of impermeable Material to at least 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

605.3.5 Outlet Laterals

The Contractor shall place non-perforated pipe in the unlined trench with ends firmly joined as recommended by the manufacturer for the specific application.

After the Department inspects and approves the pipe installation, the Contractor shall backfill the trench with approved Material in layers and compact in accordance with Section 206.3.1, "Construction Requirements, General."

605.3.6 Exposed Drain Outlets

The Contractor shall provide hardware screens for openings of exposed drain outlets. The Contractor shall mechanically secure the screen along the circumference of the outlet without damaging the drain. The Contractor shall provide precast concrete headwall with hardware screen when specified in the Contract.

605.4 METHOD OF MEASUREMENT—RESERVED

605.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Underdrains</i>	Linear Foot
<i>Vertical Drains</i>	Linear Foot
<i>French Drains</i>	Linear Foot

The Department will pay for excavation in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

605.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. All open-graded aggregate;
2. Geotextiles;
3. Pipe;
4. Precast concrete headwall with hardware screen (rodent shield);
5. Hardware; and
6. Compaction.

SECTION 606: METAL BARRIER, CABLE BARRIER AND CONCRETE WALL BARRIER

606.1 DESCRIPTION

This Work consists of constructing guardrail, permanent concrete wall barrier (CWB), temporary concrete wall barrier (TCWB), end treatments, transitions, and protection systems.

606.2 MATERIALS

606.2.1 Guardrail

The types of guardrail are as follows:

1. Single face W-beam guardrail;
2. Double faced W-beam guardrail;
3. Single face Thrie beam guardrail; and
4. Double faced Thrie beam guardrail.

Each guardrail type shall have galvanized rail elements unless otherwise specified in the Contract. The Contractor shall use Materials for guardrail installations in accordance with the current edition of the AASHTO Task Force 13 *Guide to Standardized Highway Barrier Hardware*.

606.2.1.1 Rail Elements

606.2.1.1.1 Galvanized Guardrail

The Contractor shall provide guardrail elements with a corrugated beam in accordance with AASHTO M 180, Type 2, Class A.

The Contractor shall galvanize steel rail elements before or after fabrication in accordance with AASHTO M 180 if necessary.

The Contractor shall provide required hardware and fittings in accordance with AASHTO M 30 for the specified diameter and strength class.

606.2.1.1.2 Weathering Guardrail

The Contractor shall provide corrosion-resistant "weathering" guardrail Materials if specified in the Contract. Weathering guardrail Materials shall consist of A 606 Type 4 steel, be in accordance with AASHTO M 180, Class A, Type 4 standards, and shall ensure they have a corrosion resistance at least four (4) times that of plain carbon steel.

606.2.1.1.3 Double Nested Guardrail

The Contractor shall provide a second rail element attached to each face as specified in the Contract. The second rail element shall have the same galvanization or "weathering" properties as that of the exterior rail element.

606.2.1.2 Fasteners

Unless otherwise specified, the Contractor shall galvanize fasteners in accordance with AASHTO M 111 or ASTM A 153. The Contractor shall galvanize after fabrication.

The Contractor shall provide bolts in accordance with ASTM A 307 and nuts in accordance with ASTM A 563, Grade A or better.

The Contractor shall provide fasteners for weathering guardrail in accordance with AASHTO M 180 for Type 4 steel.

606.2.1.3 Posts

606.2.1.3.1 Reserved

606.2.1.3.2 Structural Shape Posts

The Contractor shall provide structural shape posts in accordance with ASTM A 36 and galvanize them in accordance with ASTM A 123. The Contractor shall not perform punching, drilling, or cutting after galvanizing. The Contractor shall provide posts for guardrail in accordance with NCHRP Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features and the AASHTO Manual for Assessing Safety Hardware (MASH).

606.2.1.4 Offset Blocks

606.2.1.4.1 Wood Offset Blocks

The Contractor shall provide wood offset blocks as specified for the guardrail and end treatment type. Wood offset blocks shall be Southern Yellow Pine, Western Larch, Ponderosa Pine, Douglas Fir, or Lodgepole Pine and either rough sawn (unplaned) or S4S with nominal dimensions specified and with a stress grade of at least 1,200 psi.

The size tolerance of rough-sawn blocks in the direction of the bolt holes will be within $\pm 1/4$ inch of specified dimensions. The Contractor shall only use one (1) combination of post and block for any one (1) continuous length of barrier.

The Contractor shall provide wood preservatives and treatment in accordance with AASHTO M 133 or AWPA Standard U1, Commodity Standard B: Posts.

606.2.1.4.2 Plastic and Composite Offset Blocks

The Contractor shall provide plastic or composite offset blocks as specified for the guardrail and end treatment type and in accordance with the guardrail manufacture's recommendations.

The Contractor shall ensure Suppliers of plastic or composite blocks proposed for inclusion on the Department's Approved Products List submit certification to the Project Manager for approval by the State Traffic Engineer.

606.2.2 Cable Barrier

606.2.2.1 General Requirements

TL4 is required when installed on slopes 6:1 or flatter. Systems shall meet TL-3 when installed on slopes between 4:1, and 6:1. End anchors shall meet TL-3. High tension post and cable barrier shall not be installed on slopes exceeding 4:1. The system shall utilize four (4) pre-stretched wire ropes. Post spacing shall be based on an eight (8) foot maximum deflection with post spacing not exceeding ten (10) feet or as recommended by the manufacture.

606.2.2.2 Submittal

A minimum of three (3) weeks prior to the Pre-Construction Conference, the Contractor shall submit three (3) complete sets of manufacturers' Certificates of Compliance, manufacturer's most current product manuals covering installation and maintenance of the installation, and shop drawing submittal to the Project Manager.

The shop drawing submittal shall specify all components/Materials (i.e. part numbers) used in the complete cable barrier system for each location. The manufacture approved final layout, post spacing, concrete socketed post foundation design, concrete end anchors foundation design, and geotechnical investigations (reports and soil boring logs) shall be included in the submittal. The Contractor shop drawing submittal shall be signed, and sealed by a Professional Engineer currently registered in the State of New Mexico.

The Contractor's submittal will require written concurrence and approval by the Department, no Work shall commence until the Department has concurred. Written approval by the Department does not relieve the Contractor's responsibility for providing and installing a high tension post and cable barrier system meeting NCHRP Report 350.

606.2.2.3 Cost Breakdown

The Contractor shall submit a cost breakdown summary of all components/Materials (i.e. part numbers) required for each completed permanent installation.

The Contractor shall provide this cost breakdown summary to the Project Manager at least three (3) weeks prior to the Pre-Construction Conference. A minimum of five (5) copies shall be provided to the Project Manager.

The Contractor shall not be allowed to initiate any Work on the Project until a cost breakdown summary has been provided, and is approved by the Project Manager.

606.2.2.4 Materials

The Contractor shall provide Materials for post and cable barrier certified to meet the testing requirements in accordance with NCHRP Report 350 or as indicated on the Plans. The Contractor shall use Materials of the manufacturer's latest approved design. The Contractor shall use Materials of a uniform type, and from a single manufacturer. The Contractor shall not mix component parts.

The cable shall be $\frac{3}{4}$ inch, three (3) x seven (7), pre-stretched galvanized wire rope meeting the requirements of AASHTO Designation M 30/ ASTM Designation A 741, Type 1, Class A coating, having a Modified Breaking Strength equal to 39,000 pounds. The cables shall be pre-stretched to a minimum wire rope modulus of elasticity of 19,000,000 psi in accordance with ISO 12076-202 Wire Rope Modulus of Elasticity "Initial" (as manufactured), with no bedding (or pre-stretching) of the rope permitted in testing. Samples for proof-testing will be required to assure that wire ropes and connections meet or exceed the minimum breaking load for the rope. The wire rope shall be pre-stretched during manufacturing to exhibit a minimum modulus of elasticity of 11,805,090 pounds/in² after pre-stretching. Each cable shall be individually anchored.

Only swaged fittings shall be provided. Field-installed, galvanized-steel fittings (i.e., turnbuckles and splices) shall be one (1) inch diameter. Factory applied or stainless steel fittings shall be per the manufacturer's Specifications. Fully fitted ropes shall develop a Minimum Breaking Load (MBL) of 36,800 pounds. Only threaded ends, swaged onto the cables shall be used for connecting the cables to the turnbuckles. However, a maximum of

two (2) field-installed connectors per wire rope per run may be used if needed for run length adjustment. These connectors, if used, shall utilize a threaded-end socket to secure the wedge by compression.

Posts shall be installed in socketed drivable or concrete foundations utilizing a metal sleeve for insertion of the post. The vertical plumbness of the posts shall be within one-quarter inch (1/4"). Low-density polyethylene post caps shall be placed on top of each post. Posts, end anchor components, metal socket sleeves, and incidentals shall be galvanized to ASTM A-123 after fabrication.

Retro-reflective sheeting providing at least ten (10) in² of reflective area shall be attached to both sides of the last five (5) posts at each end of the end terminal, then throughout the remainder of the installation at a maximum spacing of 30 feet. The spacing shall be adjusted to 15 feet on curves having a radius less than 3500 feet. The sheeting shall be yellow the same color as the adjacent edge line. The Contractor shall attach sheeting near the top of the post in a manner recommended by the manufacturer and to the side of the post from which vehicle impacts are most likely. For installations where impacts are likely to occur from either side, the Contractor shall apply the sheeting to both sides of the post.

Each post shall have a low-density polyethylene excluder gasket, profiled to fit tightly around each post, placed so to prevent debris from entering the socket, and at least one (1) reinforcing ring, together with other reinforcement as recommended by the manufacturer.

606.2.2.5 Concrete and Steel Reinforcement

The Contractor shall provide concrete and steel reinforcement in accordance with manufacturer's recommendations and in accordance with Section 510, "Portland Cement Concrete" and Section 540, "Steel Reinforcement".

606.2.2.6 Construction Requirements

The Contractor shall fabricate, assemble, and install post and cable barrier in accordance with these Specifications, manufacturer's recommendations, and the approved shop drawings submittal.

The Contractor shall perform all geotechnical investigations, which include all reports, and soil boring logs necessary for completing the post and cable barrier design. No additional payment will be made to the Contractor for geotechnical investigations or any other analysis required subsequent to the sealed shop drawing submittal.

Each post foundation shall be constructed to the size and shape recommended by manufacturer based on soil and ground conditions, but minimum size shall be 12" diameter by 36" deep (12" x 36"). Excavated Materials shall not fall back into the hole.

End anchor foundations shall be designed based on soil conditions to meet the manufacturer's Specification. Excavations shall be in natural, undisturbed ground; if over-excavation is unavoidable, the sides shall be vertical and additional concrete used to completely fill the excavated area. Alternatively, foundations may be formed and cast, then backfilled to a minimum 95% compacted density.

At locations where the proposed post and cable barrier does not interfere with the functioning of the existing guardrail, the Contractor shall not remove the existing guardrail until the post and cable barrier system is fully functional. Once the installation is fully functional, the Contractor shall remove existing guardrail within five (5) Working Days.

606.2.2.7 Tensioning

Tensioning of the cables shall be in accordance with the manufacturer's instructions and Specifications. Tension charts shall have a minimum range of -20° F to 180° F.

Cable tension shall be deemed Acceptable when the following three (3) conditions are met:

1. The entire system is initially tensioned to full compliance in accordance with the manufacturer's Specifications;
2. A minimum of 21 Days after the initial tensioning, a second tensioning shall be done with successive tension measurements at every turnbuckle on each cable being adjusted to the manufacturer's Specifications; and
3. The manufacturer certifies that the full cable system has been tensioned in accordance with their Specifications and complies with the manufacturer's tension requirements.

The manufacturer shall provide a recommended tension chart for their system. The chart shall be indexed using cable temperature, in degrees Fahrenheit, as the independent variable and tension, in pounds (force), as the dependent variable. Tension measurements shall be taken in the vicinity of every turnbuckle on each cable within a segment as directed by the manufacturer.

The Contractor shall maintain a tension log showing Project name, time and date, weather conditions, segment termini, cable temperature, tension measurement location, stationing, mile marker, and actual tension reading. The person(s) performing the testing shall sign the tension log daily. The log, along with the manufacturer's recommended tension chart, shall be provided to the Project Manager prior to the cable barrier Subcontractor leaving the Project.

The Contractor shall obtain on-site assistance from the manufacturer during installation, unless the Contractor can prove previous experience with the installation of the post and cable barrier system. The Contractor shall ensure a manufacturer's representative is present for Final Acceptance of the post and cable barrier installation.

606.2.3 Concrete Wall Barrier (CWB) and Temporary Concrete Wall Barrier (TCWB)

The types of CWB are as follows:

1. Slip-formed CWB;
2. Cast-in-place CWB; and
3. Precast CWB.

CWB shall be installed by slip-forming or cast-in-place. TCWB shall be precast.

The Contractor shall use Class A concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs." The Contractor shall provide reinforcing steel in accordance with Section 540, "Steel Reinforcement." The Contractor shall provide preformed asphalt joint filler in accordance with AASHTO M 213. The Contractor shall provide penetrating water repellent in accordance with Section 532, "Penetrating Water Repellent Treatment."

A 3/8" diameter, ASTM A416 Grade 270, AASHTO M 203M, uncoated seven (7)-wire steel strands may be substituted for the AASHTO M31, Grade 60 deformed bars provided that the steel strands are uncoated, clean and free from dirt, loose rust, oil, grease or other Deleterious Material, for Slip-formed CWB.

606.2.3.1 CWB Steel Access Panel

The Contractor shall provide and install CWB steel access panels in accordance with the Plans or as directed by the Project Manager.

The Contractor shall contour the steel access panel to the shape of and flush with the CWB. The Department will not allow the steel access panel to compromise the structural integrity and performance of the CWB assembly. The Contractor shall provide steel in accordance with AASHTO M 270, Grade 36. The Contractor shall coat the steel access panel in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

606.2.4 End Treatments

The types of end treatments are as follows:

1. End Treatment – W-beam TL-3 end terminal (for all speeds);
2. End Treatment – W-beam TL-2 end terminal (for speeds of 40 mph or less);
3. End Treatment – W-beam end anchor;
4. End Treatment – Thrie beam end anchor; and
5. End Treatment – W-beam driveway end anchor (for curved guardrail for minor approaches and driveways).

The Contractor shall provide End Treatments on the Department's Approved Products List which are required to meet NCHRP Report 350 or the AASHTO Manual for Assessing Safety Hardware (MASH).

W-beam TL-3 End Terminals may be used for all posted speeds.

W-beam TL-2 End Terminals may be used for posted speeds of 40 mph or less.

W-beam End Anchors shall be used on the downstream end of W-beam guardrail runs when a crash-worthy TL-3 or TL-2 terminal is not required.

Thrie beam End Anchors shall be used on the downstream end of thrie beam guardrail runs when a crash-worthy TL-3 or TL-2 end terminal is not required.

Driveway End Anchors maybe used on curved W-beam guardrail installations at minor Roadway intersections such as driveways and low speed Roadway approaches to the mainline.

606.2.5 Transitions

Transition types may include the following or others as specified in the Contract:

1. Transition from W-Beam to thrie beam;
2. Transition from guardrail to rigid barrier; or
3. Transition from existing guardrail to 31" guardrail.

606.2.6 Protection Systems

Protection Systems may include the following or others as specified in the Contract:

1. Median Protection System; or

2. Drainage Structure Protection System.

Each system is comprised of W-beam, thrie beam, and expansion/reducer sections working in conjunction to provide increased protection for Bridge piers, fixed objects and drainage Structures. The minimum lengths required for each component of the system, as well as the required post spacing, shall be as indicated in the Contract.

606.2.7 Materials Certification

The Contractor shall provide MTRs and Certificates of Compliance in accordance with Section 106.4 "Certificates of Compliance" to the Project Manager, certifying that the Materials and fabrication are in accordance with these Specifications. Fabrication shall be done by an identifiable source.

606.2.8 Member Identification and Marking

The Contractor shall ensure the manufacturer permanently stamps the specific type of guardrail end treatment at each location to correspond with those shown on the shop drawings provided to the Project Manager, so that each is readily identifiable in the field.

606.2.9 Reflective Barrier Delineators

The Contractor shall provide amber-colored reflective barrier delineators for median barriers and white reflectors for shoulder-side barriers in accordance with the Contract and Section 703, "Traffic Markers."

The Contractor shall place reflective barrier delineators back to back on median barriers.

606.3 CONSTRUCTION REQUIREMENTS

During construction, the Contractor shall prevent exposed Steel or concrete barrier ends from creating a hazard to the traveling public.

606.3.1 Guardrail Installation

Installation of guardrail shall be done by personnel certified by the manufacturer. The Contractor shall provide certifications to the Project Manager prior to commencing Work.

The Contractor shall position steel parts stored in transit, in open cars or trucks, or outside in yards or at job sites to allow free drainage and air circulation. The Contractor shall handle fabricated steel parts to avoid gouges, scratches, and dents.

The Contractor shall keep the steel clean of Deleterious Material. If the Contract specifies a weathering guardrail, the Department will not consider natural oxidation (mill scale) to be Deleterious Material and will not allow galvanizing, blast cleaning, or pickling of weathering guardrail to remove the mill scale.

The Contractor shall draw bolts tight (except adjustment bolts). The Contractor shall use bolts that are long enough to extend beyond the nuts.

606.3.1.1 Steel Posts

The Contractor shall set posts plumb, in hand-dug or mechanically made holes, or by driving. If upward vertical adjustment of posts is necessary, the Contractor shall remove and reinstall the post.

606.3.1.1.1 Steel Posts in Asphalt

The Contractor shall construct a leave out for all W-beam locations in asphalt.

The Contractor shall perform post drilling or driving operations that does not cause bulging, distressing, or other disturbance of the asphalt surface.

If bulging or other distress of the asphalt surfacing occurs when drilling or driving steel posts, the Contractor shall remove and reinstall these posts using guide holes drilled through the asphalt surfacing. The Contractor shall make the guide holes with a minimum eight (8) inch diameter.

If after precutting or drilling the guide holes, bulging or other distress of the asphalt surfacing occurs or if posts cannot be driven to the specified depths, the Contractor shall cease the driving, remove the posts, and extend the guide holes as necessary or as directed by the Project Manager.

The Contractor shall backfill and compact postholes with Acceptable Department approved Material, such as Base Course or cold mix, placed in thin layers, to within three (3) inches of the surface grade. The Contractor shall place three (3) inches of Base Course in accordance with Section 303, "Base Course." The Contractor shall manually tamp and neatly level to surface grade. The Contractor shall apply an emulsion to the leave out area within 24 hours of compaction as approved by the Project Manager.

Steel posts in asphalt thicker than eight (8) inches shall be constructed as steel posts in rock per Section 606.3.1.1.3, "Steel Posts in Rock."

606.3.1.1.2 Steel Posts in Concrete

The Contractor shall construct a leave-out for all W-beam and thrie-beam locations in concrete.

The Contractor shall backfill and compact postholes with Acceptable Material, such as Base Course or cold mix, placed in thin layers, to within three (3) inches of the surface grade. The Contractor shall place three (3) inches of Base Course in accordance with Section 303, "Base Course." The Contractor shall manually tamp and neatly level to surface grade. The Contractor shall apply an emulsion to the leave out area within 24 hours of compaction as approved by the Project Manager.

606.3.1.1.3 Steel Posts in Rock

When W-beam posts are restrained by asphalt or concrete surfacing, a leaveout shall be constructed.

The Contractor shall perform post drilling operations that does not cause bulging, distressing, or other disturbance of the asphalt surface.

If bulging or other distress of the asphalt surfacing occurs when driving steel posts, the Contractor shall remove and reinstall these posts using guide holes drilled through the asphalt surfacing. The Contractor shall make the guide holes with a minimum eight (8) inch diameter.

If after precutting or drilling the guide holes, if bulging or other distress of the asphalt surfacing occurs or if posts cannot be driven to the specified depths, the

Contractor shall cease the driving, remove the posts, and extend the guide holes as necessary or as directed by the Project Manager.

The Contractor shall backfill and compact postholes with Acceptable Material, such as Base Course or cold mix, placed in thin layers, to within three (3) inches of the surface grade. The Contractor shall place three (3) inches of Base Course in accordance with Section 303, "Base Course." The Contractor shall manually tamp and neatly level to surface grade. The Contractor shall apply an emulsion to the leave out area within 24 hours of compaction as approved by the Project Manager.

606.3.1.2 Thrie Beams and W-Beams

The Contractor shall erect smooth and continuous rail elements. The Contractor shall overlap rails in the same direction as the traffic flow of the nearest lane. The Department will only allow such drilling or cutting that is necessary for special connections and for sampling in the field.

The Contractor shall shop-fabricate curved rails having a radius of 150 ft. or less to the appropriate curvature specified in the Plans.

606.3.1.3 Repair of Damaged Coating

If the galvanizing of guardrail or appurtenances is damaged, the Contractor shall repair the coating by galvanizing or by coating with two (2) coats of zinc dust-zinc oxide paint in accordance with Federal Specification TT-P-641 or Military Specification ML-P-21035.

606.3.2 Reserved

606.3.3 Concrete Wall Barrier and Temporary Concrete Wall Barrier Installation

606.3.3.1 Concrete Wall Barrier and Temporary Concrete Wall Barrier Fabrication

The Contractor shall fabricate CWB in accordance with Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures."

The Contractor shall construct TCWB in accordance with the Plans.

The Contractor shall construct CWB in accordance with the Plans. The Contractor shall ensure that the top of the completed barrier does not deviate from the Plans more than ± 0.19 inches. The Contractor shall place reinforcement in accordance with Section 540, "Steel Reinforcement." The Contractor shall give the CWB a Class 2, Rubbed Surface Finish, or Class 4, Special Surface Finish, in accordance with Section 511.3.8, "Finishing."

The reinforcement shall be placed as shown on the approved drawings. When substituting steel strands caution must be taken to prevent and avoid displacement from detailed orientation.

If the manufacturer requires sandblasting, the Contractor shall not displace mortar used in the surface finish from the bubble pockets, pits, depressions, and honeycombs.

The Contractor shall cure CWB in accordance with Section 511.3.9, "Curing."

The Contractor shall treat the entire exposed surfaces of CWB with penetrating water-repellent treatment in accordance with Section 532, "Penetrating Water Repellent Treatment."

When called for in the Contract, the Contractor shall apply penetrating water repellent first, then the Special Surface Finish.

The Department will not require fly ash in the PCC used to fabricate TCWB.

606.3.3.2 Permanent Concrete Wall Barrier Joint Treatment

When sawing transverse weakened-plane joints, the Contractor shall perform the sawing after the concrete has hardened enough to prevent raveling, crumbling, or shape deformation. The Contractor shall saw control joints at intervals designated in the Plans or as directed by the Project Manager. After completing the sawing operations, the Contractor shall clean the sawed area of debris.

The Contractor shall make a construction joint after the day's permanent placement operations and at locations when concrete placement is interrupted for 30 minutes or more.

606.3.3.3 Permanent Concrete Wall Barrier Installation

The Contractor shall construct footings and foundations, and prepare the Subgrade to 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified) as necessary, before placing the CWB.

The Contractor shall construct vertically offset (atypical) CWB as specified in the Plans.

606.3.3.3.1 Temporary Concrete Wall Barrier Requirements

The Contractor shall precast TCWB as specified in the Plans. The Contractor shall not intermix CWB of different designs, shapes, or lengths. The Contractor shall set TCWB in accordance with the Contract and the approved traffic control Plan. The Contractor shall provide necessary loading, hauling, and unloading at designated sites.

The Contractor shall reset the TCWB during construction, as required by the Contract.

After completing the project, the Contractor shall remove, load, haul, unload, and stockpile the Department retained or Department provided CWB at the locations required in the Contract or as directed by the Project Manager.

606.3.3.3.2 Temporary Concrete Wall Barrier (Retained by the Contractor)

If the Contract specifies TCWB retained by the Contractor, the Contractor shall provide new or used TCWB. TCWB retained by the Contractor will remain the property of the Contractor upon completion of the Project.

The Contractor shall provide connecting hardware for the TCWB assembly.

606.3.3.3.3 Temporary Concrete Wall Barrier (Retained by the Department)

If the Contract specifies TCWB retained by the Department, the Contractor shall provide new TCWB.

TCWB retained by the Department, including shop drawings and connecting hardware, as approved by the Project Manager, will become the property of the Department upon completion of the Project.

The Contractor shall remove, dispose and replace Department retained TCWB that is not Accepted by the Project Manager.

606.3.3.3.4 Department-Furnished Temporary Concrete Wall Barrier

If the Contract specifies Department-furnished TCWB, the Contractor shall load, haul, and unload Department-furnished TCWB from origins to destinations.

Department-furnished TCWB will remain the property of the Department upon completion of the Project.

If the Contract specifies Department-furnished TCWB, the Contractor shall provide connecting hardware for the TCWB assembly, if missing from the TCWB units.

606.3.4 End Terminal or End Anchorage Installation (End Treatment Systems)

The Contractor shall install end treatment systems in accordance with the manufacturer's recommendations and approved shop drawings. Installations shall be performed by certified personnel.

606.3.5 Transition Installation

The Contractor shall install transitions in accordance with the Contract and approved shop drawings.

606.3.6 Protection System Installation

The Contractor shall install Protection Systems in accordance with the Contract and approved drawings.

Assembly and installation of each component of the Protection System shall be supervised at all times by the Contractor's representative certified by the manufacturer.

606.3.7 Embankment Grading Requirements

The Contractor shall compact Embankment Material to 95% of maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). Unless otherwise specified in the Contract, the ground surface between the edge of the shoulder and the hinge point of the slope behind the guardrail shall be graded at 10:1 (H:V) or flatter. The Contractor shall warp all grade transitions to create smooth surface contours.

606.3.8 Drainage Requirements

The Contractor shall provide guardrail drainage components as specified in the Contract.

Unless otherwise specified, a minimum thickness of 1 ½ inches of hot/warm mix asphalt shall be placed and compacted beneath the guardrail area.

Asphalt curb or concrete curb may be used to direct surface runoff as specified in the Contract. Metal curbs are not allowed. For Transitions from guardrail to rigid barrier, the Contractor shall not extend the asphalt curb or concrete curb beyond the thrie beam to W-beam reducer element. If additional curb length is needed, then the Contractor shall extend the curb through the entire Transition and add 12.5 ft. of nested W-beam adjacent to and upstream of the thrie beam to W-beam reducer element. All asphalt curb or concrete curb shall be placed below the guardrail offset block with the face of the curb aligned with the face of the guardrail.

606.3.9 Vegetation Management Requirements

The Contractor shall provide vegetation management as specified in the Contract. Vegetation management may consist of asphalt paving, concrete paving, or application of an approved herbicide.

606.4 METHOD OF MEASUREMENT

606.4.1 Guardrail Measurement

Guardrail will be measured and paid in linear feet of guardrail that has been satisfactorily completed and Accepted, exclusive of that length of guardrail that is within the pay limits of end treatments, transitions and linear feet of protection system as specified. Measurement will be made along the centerline of the barrier.

Weathering Guardrail will be measured and paid in linear feet of guardrail that has been satisfactorily completed and Accepted, exclusive of that length of guardrail that is within the pay limits of end treatments and transitions, transitions and linear feet of protection system. Measurement will be made along the centerline of the barrier.

Curved Guardrail will be measured and paid as linear feet of standard Guardrail or three beam.

606.4.2 Cable Barrier Measurement

The Department will measure the post and cable barrier installation along the face of the barrier from end to end for each section. End anchors will be paid by the each.

606.4.3 Concrete Wall Barrier Measurement

CWB and TCWB will be measured along the centerline of the barrier. CWB flare within CWB Transition Section will be measured as CWB.

606.4.4 End Terminal or End Anchor (End Treatment System) Measurement

End Treatment Systems will be measured and paid in units of each completed and Accepted, inclusive of integral transition sections connecting the End Treatment to the corresponding guardrail or concrete wall barrier. Each End Treatment is inclusive of all necessary posts, blocks, connections, anchorage, fasteners, grading, drainage elements, vegetation management components and leave-outs.

606.4.5 Transition Measurement

Transitions will be paid by each for transitions that have been satisfactorily completed and Accepted. Measurement will be made along the transition centerline and exclusive of that length of barrier that is within the pay limits of end treatments or the corresponding guardrail or concrete wall barrier. Transitions that are integral to the end treatment system shall be considered to be part of the end treatment system and shall not be measured or paid separately. Each Transition is inclusive of all necessary anchorage fasteners, grading, drainage elements, and vegetation management components.

606.4.6 Protection System Measurement

Protection Systems will be measured and paid in units of linear feet of the protection system that has been satisfactorily completed and Accepted. Measurement will be made

along the protection system centerline and exclusive of that length of barrier that is within the pay limits of end treatments. Each Protection System is inclusive of all necessary anchorage, fasteners, grading, drainage elements, vegetation management components and leave-outs.

606.4.7 Removal and Reinstall Guardrail

Remove and Reinstall Guardrail will be measured and paid in linear feet of guardrail that has been satisfactorily removed, replaced, and Accepted exclusive of end treatments and transitions. Measurement will be made along the railing face center to center of the outermost post in the length of guardrail being measured.

606.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Guardrail</i>	Linear Foot
<i>Weathering Guardrail</i>	Linear Foot
<i>End Terminals</i>	Each
<i>End Anchors</i>	Each
<i>Transitions</i>	Each
<i>Protection Systems</i>	Linear Foot
<i>Remove and Reinstall Guardrail</i>	Linear Foot
<i>Post and Cable Barrier</i>	Linear Foot
<i>Post and Cable Barrier End Anchor</i>	Each
<i>Concrete Wall Barrier</i>	Linear Foot
<i>TCWB Retained by the Department (___ ft)</i>	Linear Foot
<i>Resetting of TCWB (___ ft)</i>	Linear Foot
<i>Department-Furnished TCWB (___ ft)</i>	Linear Foot
<i>TCWB Retained by the Contractor (___ ft)</i>	Linear Foot
<i>Concrete Wall Barrier (Modified)</i>	Linear Foot
<i>Concrete Wall Barrier (Half Section)</i>	Linear Foot

606.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. All loading, hauling, unloading, stockpiling, or disposal;
2. Moving or removal of temporary barrier;
3. Footings and foundations;
4. Offset Blocks;
5. Reflective sheeting and reflectors installed on guardrail, end treatments, and transitions;
6. End treatment posts, sleeves, anchors, barrier rail and impact head;
7. Backfilling and compacting of holes created by removal and installation of posts;
8. Embankment Material, placement, and grading;
9. Placement and compaction of asphalt Material;
10. Construction of surfacing;

11. Construction of post leaveouts;
12. Construction of asphalt curbs;
13. Patching Material at posts;
14. All connecting hardware;
15. Manufacturers' certificates, literature, and shop drawings (Professional Engineer submittal);
16. When required; Assistance from the manufacturer during installation and manufacturer's representative presence for Pre-Construction meeting;
17. Manufacturer's representative presence for Final Acceptance;
18. End Anchorage treatments; all connecting hardware; wire rope;
19. Design of post foundations per manufacturers recommendations;
20. Concrete, reinforcing steel, excavation, backfill, and any Work or Materials required for post foundation construction per manufacturers recommendations;
21. Patching Material to existing Hot Mix Asphalt, Base Course and Open- Graded Friction Course;
22. Installing all posts with caps; reflectors;
23. All labor; Equipment; tools;
24. Replacement of damaged posts during construction;
25. All Quality Control (QC), includes all sampling and testing by the Contractor;
26. All geotechnical investigations (reports and soil boring logs);
27. Modifications to the cable barrier system subsequent to the shop drawing submittal;
28. Reflective barrier delineators installed on CWB and TCWB;
29. Curing of CWB and application of penetrating water-repellent treatment;
30. Connection pins and anchors for TCWB;
31. Concrete wall barrier access panel;
32. Reinforcing Steel;
33. Transitions that are integral to end treatment systems;
34. Replacement of unacceptable Department retained TCWB due to Contractor mishandling;
and
35. Guardrail post installation in rock.

SECTION 607: FENCE

607.1 DESCRIPTION

This Work consists of constructing fence and gates.

607.2 MATERIALS

607.2.1 Certification

The Contractor shall submit independent testing Laboratory certification to the Project Manager that indicates the fencing Materials meet these Specifications. The Department may inspect the manufacturing methods at manufacturing plants and may obtain Material samples for testing and may base Acceptance on the quality of manufacturing lots.

607.2.2 Barbed Wire and Woven Wire Fence

607.2.2.1 Wire

The Contractor shall provide wire and wire components with at least a Class 1 zinc coating in accordance with ASTM A 121 or ASTM A 116, unless otherwise specified in the Contract. Instead of Class 1 coating, the Contractor may coat the wire with aluminum alloy covering at least 0.3 oz per square foot of wire surface.

607.2.2.1.1 Barbed Wire

The Contractor shall provide barbed wire and barbs in accordance with ASTM A 121. The Contractor shall provide composite barbed wire strands that consist of two (2) coated wires with diameters of 0.099 inch. The Contractor shall provide round barbs that have a coated diameter of 0.08 inch, with either two (2)-point barbs spaced four (4) inches apart or four (4)-point barbs spaced five (5) inches apart. The Contractor shall provide stays for barbed wire fences in accordance with ASTM A 116, with a coated diameter of at least 0.142 inch and with lengths and spacing in accordance with the Contract.

607.2.2.1.2 Woven Wire

The Contractor shall provide woven wire in accordance with ASTM A 116, Design Number 832-6-11, unless otherwise specified in the Contract.

607.2.2.1.3 Post Fasteners

The Contractor shall provide coated staples with a diameter of at least 0.148 inch and a length of at least 1 1/2 inch; use for fastening fence wire to wood posts.

607.2.2.1.4 Brace Wire

The Contractor shall provide coated brace wire with a diameter of at least 0.148 inch; use for constructing braces and intermediate braces with wood posts.

607.2.2.1.5 Tie Wire

The Contractor shall provide coated tie wire for fastening barbed or woven wire to steel posts with a diameter of at least 0.099 inch. The Contractor may use wire fasteners or metal clamps with thicknesses of 0.12 inch or greater instead of tie wires, if approved by the Project Manager.

607.2.2.2 Posts

The Contractor shall provide metal or wood corner, brace, intermediate brace gate, and line posts of the specified type, size, and length in accordance with the Contract. The Contractor shall permanently cap all vertical metal pipes on fence and gate supports. The Contractor shall ensure that the top coating and color of the pipe is maintained.

607.2.2.2.1 Metal Posts

The Contractor shall provide metal posts and braces of rail, billet, or commercial-grade steel in accordance with ASTM A 702 or ASTM F 1083 for galvanized, standard weight pipe. The Contractor shall provide C-section posts in accordance with ASTM A 1011.

The Contractor shall galvanize steel posts in accordance with AASHTO M 181 for Grade 1 steel and provide a top coating specified for Grade 2 steel, or an equivalent or better coating, from the Department's *Approved Products List*. The Contractor shall coat edges and damaged areas of posts in accordance with ASTM A 780. The Contractor shall use posts of the same coating and color.

The Contractor shall provide posts that weigh no less than 95% of the specified weight; and are of the specified length + two (2) inch, - one (1) inch.

The Contractor shall provide line posts with a minimum weight of 1.33 lb per foot, not including anchor plates. The Contractor may provide I-beam, T-beam, U-beam, Y-bar, or C-section line posts. The Contractor shall provide line posts with corrugations, lugs, ribs, or notches spaced one (1) inch on centers to attach fence wire. The Department will not Accept posts with punched tabs used for crimping around the wire.

The Contractor shall provide anchor plates with an area of at least 18 inch² and that weigh at least 0.67 lb. The Contractor shall clamp, weld, or rivet anchor plates to the post section to prevent displacement when driving the posts.

607.2.2.2.2 Wood Posts

The Contractor shall provide wood posts cut from live southern yellow pine, lodge pole pine, or ponderosa pine trees. The Contractor shall provide straight posts that are free of decay and other defects, bark-free, trimmed smooth of knots and projections, and with both ends sawed off perpendicular to the centerline.

The Contractor shall provide an average nominal diameter at the top of each post of at least six (6) inches. The Contractor shall ensure the circumference of corner, brace, intermediate brace, and gate posts is at least 19 inches, measured six (6) inches below the top of the post.

The Contractor may provide line posts with a slight crook in one (1) direction, but the post may not vary more than 1 1/2 inch from a straight line connecting both ends of the post. The Contractor shall ensure the average nominal diameter of the top of each line post is at least three (3) inches. The Contractor shall ensure the circumference of line posts is at least nine (9) inches, measured six (6) inches below the top of the post.

The Contractor shall provide coast region douglas fir or New Mexico red spruce or fir braces for wood posts.

607.2.2.2.2.1 Preservative Treatment of Wood Posts

The Contractor shall provide wood posts pressure treated with pentachlorophenol in accordance with Section 550.2.2, "Preservatives and Treatment Methods," treated according to AASHTO M-133, all in accordance with AWPA Standard U1 and Commodity Standard B: Posts and AWPA Standards P8 and P9.

607.2.2.3 Gates

The Contractor shall provide two (2)-inch 16-gauge tubular gates meeting the requirements of ASTM A513 with a wall thickness of .065 inches and a tolerance of plus (+0.003) or minus (-0.011) unless otherwise specified in the Contract.

Gates shall be coated in accordance with Section 607.2.2.2.1, "Metal Posts," or coat in accordance with Section 545, "Protective Coating for Miscellaneous Structural Steel." The Contractor shall use "Interstate Green" as the finished color coating, except for galvanized gates and unless otherwise shown in the Contract.

607.2.2.4 Fittings

The Contractor shall provide fittings, hardware, and appurtenances for fences and gates that are of commercial-quality steel, malleable iron, or wrought iron, and galvanized in accordance with ASTM A 153.

607.2.3 Chain Link Fence

607.2.3.1 Posts

The Contractor shall provide posts that are tubular steel, H-column, or C-section (for line posts). The Contractor shall provide either Grade 1 or Grade 2 steel posts in accordance with AASHTO M 181. The Contractor shall provide Grade 1 tubular posts, braces, and top rails in accordance with ASTM F 1083 for galvanized, standard weight pipe. The Contractor shall provide Grade 2 steel posts in accordance with ASTM A 1011 or ASTM A 653.

The Contractor shall provide C-section line posts in accordance with ASTM A 1011. The Contractor shall provide H-column posts in accordance with ASTM A 36.

The Contractor shall provide pipe with minimum wall thickness as specified in the Contract. The Contractor shall ensure that the product of the yield strength and section modulus of the pipe is in accordance with ASTM F 1083.

The Contractor shall provide posts that securely hold tension wires in position without vertical movement.

607.2.3.2 Fittings

The Contractor shall provide fittings in accordance with Section 607.2.2.4, "Fittings."

The Contractor shall provide stainless steel straps and seals in accordance with ASTM A 176.

The Contractor shall provide coated tension wires that are galvanized coil spring steel wire of commercial quality with a diameter of 0.148 inch. The Contractor shall provide galvanized ferrules for tension take-up in accordance with ASTM A 1011.

The Contractor shall provide pull cable and tension truss rods with diameters of at least

3/8 inch, with drop forged turnbuckles or other approved tension devices.

The Contractor shall provide pull cable and tension wires with a minimum zinc coating of 0.8 oz per square foot of uncoated individual wire surface, tested in accordance with ASTM A 90.

The Project Manager will determine the uniformity of the coating by visual inspection. The Project Manager may reject coating with excessive roughness, blisters, discoloration spots, bruises, and flaking. The Department may make other inspections and tests at the manufacturer's plant, before shipment.

607.2.3.3 Tie Wires and Fasteners

The Contractor shall provide galvanized, coated tie wires for fastening chain link fabric to posts and rails with a diameter of at least 0.148 inch. The Contractor may provide galvanized steel or non-corrosive metal bands or fasteners instead of tie wires, as recommended by the manufacturer.

607.2.3.4 Compression Braces

The Contractor shall provide compression braces that meet the same requirements as top rails in accordance with Section 607.2.3.1, "Posts."

607.2.3.5 Chain Link Fabric

The Contractor shall provide chain link fabric in accordance with AASHTO M 181, with a Class C coating or better. The Contractor shall provide chain link fabric full height. The Contractor shall provide galvanized, coated wire with a diameter of 0.148 inch. The Contractor shall provide two (2) inch mesh fabric. The Contractor shall measure the mesh size as the distance between the wires forming parallel sides of the mesh.

607.2.3.6 Gates

The Contractor shall provide double drive, single drive, or single walk gates. The Contractor shall provide galvanized steel pipe gate frames in accordance with ASTM F 1083 and ASTM A 123.

607.2.3.7 Vinyl-Coated Chain Link Fence

The Contractor shall provide vinyl-coated chain link fences in accordance with Section 607.2.3, "Chain Link Fence," except as modified in this subsection.

If providing PVC coated chain link fabric, the Contractor shall use vinyl-coated fabric, posts, and hardware in accordance with AASHTO M 181 for Class A PVC coating. The Contractor shall continuously bond the vinyl coating (do not spray or dip) over the galvanized steel wire by the extrusion bonding process under pressure.

The Contractor shall ensure the vinyl coating resists damage from prolonged exposure to dilute solutions of common mineral acids, sea water, and dilute solutions of salts and alkali.

The Contractor shall galvanize using the electrolytic process before coating with PVC.

The Contractor shall provide wire that was vinyl-coated before weaving and is free and flexible at the joints.

607.2.4 Post and Cable Access Fence

607.2.4.1 Cable

The Contractor shall provide wire cable in accordance with AASHTO M 30. The Contractor shall provide cable of Type I, Class A, 0.75 in diameter rope, unless otherwise specified in the Contract.

607.2.4.2 Hardware and Fittings

The Contractor shall provide galvanized or cadmium plated parts, hardware, and fittings. The Contractor shall galvanize in accordance with AASHTO M 232. The Contractor shall provide cadmium plating in accordance with ASTM B 766, for Class 12, Type III. The Contractor shall provide bolts in accordance with ASTM A 307 and nuts in accordance with ASTM A 563.

The Contractor shall provide externally threaded fittings such as end tie rods, anchor rods, and splicing rods that transmit direct tensile stress, having a minimum tensile strength of 75,000 psi.

The Contractor shall provide internally threaded fittings such as turnbuckles, cable sockets, and nuts capable of withstanding a proof load that is 85% of the proof load requirements for nuts, as specified in accordance with ASTM A 563, Table 3.

The Contractor shall provide cable splices and connections that withstand a proof load equal to the tensile strength required of the attached wire rope cable.

The Contractor shall provide steel rectangular plate washers and cable clamps with a minimum tensile strength of 60,000 psi. The Contractor shall provide plain washers of ferrous metal in accordance with ANSI B 18.22.1, Type A.

607.2.4.3 Wood Posts

The Contractor shall provide wood posts from one (1) of the following species:

1. Northern White Cedar;
2. White Pine;
3. Jack Pine;
4. Red (Norway) Pine;
5. Southern Yellow Pine; or
6. Ponderosa Pine.

The Contractor shall provide posts from live trees that are stacked and properly seasoned. The Contractor shall peel the entire length of each post, closely trim knots, saw both ends square, and shave the entire length of the post to the white.

The Contractor shall provide posts with a top diameter after shaving of four (4) inches; - 1/2 inch, +1 1/4 inch.

The Contractor shall ensure posts are free of sap rot, woodpecker holes, plugged holes, ant-eaten areas, and hollow knots extending to center of the post. The Contractor shall not allow butt rot to exceed five percent (5%) of the butt area. The Contractor shall provide posts with sound tops, however, the Department will allow one (1) pipe rot not exceeding a diameter of 3/8 inch on a cedar post. The Contractor shall provide posts that do not have excessive

checking. The Contractor shall ensure that the posts do not have short kinks or more than one (1) one-way sweep exceeding two (2) inches, however, the post may have a winding twist.

The Department will not allow posts exhibiting both the maximum crook and maximum butt rot, and will not allow more than ten percent (10%) of the posts specified in the Contract to contain the maximum crook or butt rot.

The Department may reject posts with other defects that give the post an unsightly appearance or impair its durability or strength. The Contractor shall complete debarking, trimming, and sizing operations before treatment.

607.2.4.4 Preservative Treatment of Posts for Post and Cable Barrier

The Contractor shall provide pressure treated wood posts with pentachlorophenol in accordance with Section 550.2.2, "Preservatives and Treatment Methods," treated according to AASHTO M-133, in all accordance with AWPA Standard U1 and Commodity Standard B: Posts and AWPA Standards P8 and P9.

607.2.5 Snow Fence

The Contractor shall provide snow fence of 1/2 inch × 1 1/2 inch wooden pickets spaced 3 1/2 inch on center and woven between five (5) cables. Each cable will consist of at least two (2) strands of galvanized steel wire with diameters of 0.099 in or larger.

The Contractor shall provide wooden pickets that are at least 48 inches long and treated or painted in accordance with the manufacturer's recommendations.

The Contractor shall provide wire, braces, attachments, and fittings in accordance with ASTM A 116 and applicable requirements of Section 607.2.2, "Barbed Wire and Woven Wire Fence."

607.2.6 Concrete

The Contractor shall provide Class A concrete bearing blocks and anchors in accordance with Section 510, "Portland Cement Concrete." The Contractor may provide a prepackaged, pre-blended cementitious Material to which the Contractor only adds water at the site.

607.3 CONSTRUCTION REQUIREMENTS

607.3.1 General

The Contractor shall clear the fence lines of trees, bush, stumps, logs, weeds, existing fences, and other obstructions that may interfere with fence construction, unless the Project Manager requires certain trees to remain in place. The Contractor shall dispose of removed Material in accordance with Section 601, "Removal of Structures and Obstructions."

If the Contractor is to embed posts, braces, or anchors in concrete, the Contractor shall install temporary guys or bracing to hold the posts in position until the concrete sets. Unless otherwise specified, the Contractor shall not install Materials on posts and do not strain posts, braces, or anchors set in concrete until seven (7) Days after concrete placement, or until the concrete has reached a compressive strength of 2,500 psi, whichever occurs first. The Contractor shall crown the concrete at the top of the foundation to shed water.

The Contractor shall only cut the tops of posts as approved by the Project Manager. The

Contractor shall apply protective coating to cut posts in accordance with Section 607.3.8, "Repair of Damaged Coating on Pull Cables and Tension Wires."

The Contractor shall firmly attach wire and fencing to the posts and braces. The Contractor shall tightly stretch wire and install it at the required elevations. The Contractor shall place fence wire on the field side of the posts, except on the inside of curves.

At each location where an electric transmission, distribution, or secondary line crosses new fence, the Contractor shall provide and install a ground connection in accordance with the NEC®.

The Contractor shall build new fences adjacent to existing fence before removing existing fences. When removing and rebuilding fences, the Contractor shall maintain the security of livestock and protect adjacent properties and the traveling public. The Contractor shall remove the existing fence or unused Materials and neatly roll it up in single strand rolls. The Contractor shall remove the fence posts without damaging them and place the posts with the rolls of wire within the Right of Way for property owners to salvage, unless otherwise directed by the Project Manager. If the property owners do not pick the fence up within the allotted time, the Contractor shall dispose of the fence as directed by the Project Manager.

607.3.2 Barbed Wire and Woven Wire Fence

The Contractor shall set posts plumb and in accordance with the Plans. The Contractor may drive metal line posts. The Contractor shall excavate for footings and anchors in accordance with the Plans or as directed by the Project Manager. The Contractor shall place post hole backfill in thin layers and compact each layer.

The Contractor shall attach Right of Way fences to Roadway Structures, in accordance with the Plans.

607.3.2.1 Fence Tensioning

The Contractor shall stretch fence wire with a mechanical stretcher or other similar device. The Contractor shall not allow the length between pull posts to exceed 990 ft for barbed wire, and 660 ft for woven wire.

607.3.2.2 Braces and Corner Posts

The Contractor shall place intermediate braces at intervals of 990 ft or less and at every fence grade-change, such as edges of arroyos, bottoms and tops of hills, and as directed by the Project Manager. The Contractor shall maintain the required distance between the bottom wire and the ground. The Contractor shall space intermediate braces evenly between corner and gateposts or cattle guards. The Contractor shall place a corner post and brace at the intersection of cross fences and the Right of Way fence. The Contractor shall stretch the wires and firmly attach them to the corner posts.

607.3.3 Chain Link Fence

The Contractor shall install braces, tension rods, cables, hardware, and appurtenances in accordance with the manufacturer's recommendations and the Contract.

The Contractor shall not attach chain link fabric to posts until the concrete footings have reached a compressive strength of 2,500 psi, or until three (3) Days after concrete placement, whichever occurs first.

After permanently positioning posts, setting anchorages firmly, and drawing tension wires and pull cables tight with turnbuckles or other approved tension devices, the Contractor shall secure the tension wires to the posts with tension bands and tie wires. The Contractor shall secure the chain link fabric at one end and stretch away from the secured end. The Contractor shall stretch the fabric with a mechanical stretcher or other device approved by the Project Manager.

607.3.3.1 Chain Link Fence Post Placement

The Contractor shall set posts plumb in concrete footings. The Contractor shall space chain link fence posts at intervals of ten (10) feet or less. The Contractor shall measure the intervals from center to center of posts. Pull posts are line posts braced to adjacent line posts. The Contractor shall position pull posts at intervals of 500 ft or less. The Contractor shall provide end posts with an outside diameter of at least 2.875 inch. The Contractor shall brace end posts in the same way as corner posts.

607.3.3.2 Chain Link Security Fence

The Contractor shall use chain link security fence in accordance with Section 607.3.3, "Chain Link Fence." The Contractor shall supply security appurtenances on gates for access.

607.3.4 Post and Cable Access Fence

607.3.4.1 Post Placement

The Department will allow a depth of post embedment that is greater than specified in the Contract if the finished top of the post meets the required elevation. The Contractor shall compact the bottom of the holes to provide a stable foundation. The Contractor shall set the posts plumb with the front faces in a neat uniform line and with full contact on the foundation surface. The Contractor shall backfill holes with granular Material and compact in layers so the posts maintain the specified position and alignment.

Instead of setting posts in previously dug holes and backfilling, the Contractor may drive the posts, except if the Contract specifies bearing blocks. The Contractor shall only drive if there is adequate lateral stability and as long as the Shoulders and adjacent slopes are not damaged from the driving operations.

The Contractor shall remove posts that do not meet the requirements or are damaged below cutoff during driving, and replace with sound posts. If upward vertical adjustment of posts is necessary, the Contractor shall remove and reinstall them.

The Contractor may cut off the tops of posts to the elevation specified in the Contract. The Contractor shall round the tops of round posts to an approximate domed hemispherical shape centered on the axis of the post. After cutting off treated posts, the Contractor shall apply two (2) coats of pentachlorophenol preservative to the cut surfaces.

607.3.4.2 Setting of Anchors, Cable, and Fittings for Post and Cable Access Fence

If a bolt projects more than one (1) inch from the nut, the Contractor shall cut off 1/2 inch and burr. The Contractor shall paint the ends of cut-off bolts with aluminum paint. The Contractor shall bore holes for cable supports after the posts are set. The Contractor shall place end and intermediate anchorages and bearing blocks in accordance with the Contract.

The Contractor shall excavate trenches for anchor blocks to their neat lines. The Contractor shall perform excavation for anchor rod installation without excessively disturbing

the earth between the block and the anchored posts. The Contractor shall excavate holes for bearing blocks to their neat lines, then place and level the block with anchor rods in place on undisturbed soil. The Contractor shall place backfill Material and compact in layers. The Contractor shall not apply final tension to the anchor assembly until after completing the backfilling.

After completing the anchor assemblies, the Contractor shall properly adjust and securely fasten the cables, draw the cables tight, then loosen them to meet Contract requirements for the applicable temperature range.

The Contractor shall use three (3) inch wide reflective sheeting in accordance with Section 701.2.2.1, "Retroreflective Sheeting," Silver White No. 2. The Contractor shall mount the sheeting on flexible aluminum alloy. The Contractor shall fix the sheeting to each end post and at maximum intervals of 100 ft on intermediate posts, with a minimum of three (3) strips per installation. The Contractor shall completely wrap the reflective strips around each post before installing the post plate washers.

607.3.5 Snow Fence

The Contractor shall construct snow fence in accordance with the manufacturer's recommendations and the Contract.

607.3.6 Pedestrian/Bicycle Railing

The Contractor shall construct pedestrian and bicycle railing in accordance with the Contract or as directed by the Project Manager.

607.3.7 Removing and Rebuilding Fence

The Contractor shall remove and rebuild existing fences in accordance with the Contract or as directed by the Project Manager. The Contractor shall construct new fences in the same or better condition than the original fence.

The Contractor shall salvage Materials from removed fences and incorporate into the rebuilt fences. If the Project Manager determines that some Materials are not reusable, the Contractor shall replace those Materials as necessary and in accordance with Section 109.5, "Payment for Changes, Differing Site Conditions, and Extra Work."

The Contractor shall firmly reset posts to the staked alignment. The Contractor shall use the same spacing of the posts and the same number of wires strung and stapled to the posts as the original fence. The Contractor shall use new staples to fasten the wires to the posts.

607.3.8 Repair of Damaged Coating on Pull Cables and Tension Wires

The Contractor may repair pull cables and tension wires that exhibit minor damage to the zinc coating by wire-brushing the damaged area and removing loose, cracked, or weld-burned zinc coating. The Contractor shall paint the cleaned area with two (2) coats of zinc oxide-zinc dust paint in accordance with Federal Specification TT-P-641 or Military Specification MIL-P-21035 or with an equivalent coating approved by the Project Manager. The Contractor shall make repairs and provide repair Materials at no additional cost to the Department.

607.3.9 Gates

The Contractor shall fabricate and construct gates, and stile and post wire traps in accordance with the Contract.

607.3.9.1 Remove and Reset Gate

The Contractor shall remove and reset existing gates in accordance with the Contract or as directed by the Project Manager.

607.4 METHOD OF MEASUREMENT

The Department will measure fences and watergap gates along the top from outside to outside of end posts for each continuous run of fence or watergap gate.

607.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Barbed Wire Fence ___ft</i>	Linear Foot
<i>Game Fence ___ft</i>	Linear Foot
<i>Woven Wire Fence ___ft</i>	Linear Foot
<i>Chain Link Fence ___ft</i>	Linear Foot
<i>Chain Link Security Fence ___ft</i>	Linear Foot
<i>Vinyl-Coated Chain Link Fence ___ft</i>	Linear Foot
<i>Snow Fence ___ft</i>	Linear Foot
<i>Pedestrian/Bicycle Railing ___ft</i>	Linear Foot
<i>Pedestrian Screening Fence Type _____ft</i>	Linear Foot
<i>Post and Cable Access Fence ___ft</i>	Linear Foot
<i>Remove and Rebuild (type) Fence</i>	Linear Foot
<i>Standard Gate ___ft</i>	Each
<i>Barbed Wire Gate, ___ft</i>	Each
<i>Chain Link Gate, ___ft Span</i>	Each
<i>Chain Link Gate, ___ft Span by ___ft Rise</i>	Each
<i>Pipe Gate ___ft</i>	Each
<i>Water Gap Gate</i>	Linear Foot
<i>Turnstile Gate ___ft</i>	Each
<i>Remove and Reset Gate</i>	Each
<i>Stile and Post Wire Trap</i>	Each
<i>Braces/Corner Posts</i>	Each

607.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Clearing and grubbing,
2. Grading,
3. Excavation,
4. Backfill,
5. Disposal of surplus Material,
6. Concrete, fasteners,

7. Galvanizing,
8. Coating repairs; and
9. All additional bracing required for grade changes.

SECTION 608: SIDEWALKS, DRIVE PADS, AND CONCRETE MEDIAN PAVEMENT

608.1 DESCRIPTION

This Work consists of constructing Sidewalks, drive pads, detectable warning surfaces, and concrete Median pavement in accordance with these *Standard Specifications* and the Americans with Disabilities Act of 1990 (42 U.S.C. § 12101 et seq.).

608.2 MATERIALS

608.2.1 Concrete

The Contractor shall provide Class A or Class F concrete in accordance with Section 510, "Portland Cement Concrete."

608.2.2 Joint Fillers

The Contractor shall provide preformed expansion joint filler in accordance with AASHTO M 33 or AASHTO M 153.

608.2.2.1 Silicone Joint Sealant and Backer Rod

The Contractor shall provide silicone joint sealant and backer rod (bondbreaker) from the Department's *Approved Products List* and in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints."

608.2.3 Bed Course Material

The Contractor shall provide bed course Material that consists of cinders, sand, gravel, crushed stone, or other granular aggregate, with 100% passing a 1/2 inch sieve and not more than 12% passing the No. 200 sieve, or Base Course as per Section 303, "Base Course."

608.2.4 Detectable Warning Surfaces

608.2.4.1 General

The Contractor shall obtain a list of approved Suppliers from the Department's *Approved Products List*. The Contractor shall contact the Department's Office of Affirmative Action to propose alternative Suppliers. Stamped or imprinted concrete systems will not be allowed.

608.2.4.2 Color Contrast

The Contractor shall provide a light colored Material on a dark surface or a dark colored Material on a light surface to contrast with adjacent walking surfaces.

The Contractor shall use a uniform color over the entire surface that is homogenous throughout the thickness of the Material, as approved by the Project Manager.

Should a concern arise over the color contrast, the Contractor will coordinate with the Environmental Program Manager (through the Project Manager) for color contrast guidance. The Contractor shall allow a minimum of 30 Days for coordination with the Environmental Program Manager.

608.2.4.3 Contractor Submittals

The Contractor shall submit certification to the Project Manager before proposed installation describing the following:

1. The detectable warning surface Material and name of approved Supplier;
2. All associated Materials used, including bonding Material and color used for color contrast requirements;
3. Installation procedure as per manufacturer's recommendations;
4. A detailed time element regarding application to new concrete;
5. Submit a 12 inch × 12 inch sample of the detectable warning surface on concrete substrate showing the color contrast developed for the Project;
6. Certified test results indicating compliance with manufacturer recommendations; and
7. Meet ADA Requirements.

608.3 CONSTRUCTION REQUIREMENTS

608.3.1 Excavation and Backfill

The Contractor shall perform excavation or backfill to the required depth of elevation and to a width that will allow the installation and bracing of the forms. The Contractor shall remove soft and yielding Material and replace with the specified bed course Material. The Contractor shall shape and compact the foundation to a firm, even surface.

608.3.2 Bed Course Placement

The Contractor shall compact existing ground under bed course to 95% of maximum density in accordance with Section 203.3.7, "Moisture and Density Control."

The Contractor shall place at least four (4) inches of bed course Material. The Contractor shall compact bed course Material to a density of at least 90% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Contractor shall compact bed course Material for drive pads to a density of at least 96% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Contractor shall perform compaction in accordance with Section 303.3.2, "Mixing and Placing."

608.3.3 Forms

The Contractor shall use wood or metal forms that extend the full depth of the concrete. The Contractor shall ensure forms are straight, free of warps, and strong enough to resist the concrete pressure without deforming. The Contractor shall brace and stake forms so they remain in both horizontal and vertical alignment until their removal. The Contractor shall treat the forms with form release oil to prevent damage to the concrete when removing the forms. The Contractor shall use flexible forms in curved sections so that the top surface of the forms produces a smooth, continuous arc.

608.3.4 Placing Concrete

The Contractor shall moisten the foundation immediately before placing the concrete. The Contractor shall remove excess water remaining on the foundation. The Contractor shall proportion, mix, and place the concrete in accordance with the requirements for the specified concrete. The Contractor shall use cast-in-place or slip formed concrete. The Contractor shall ensure the surface of the patterned concrete pavement matches the finish grades. The Contractor shall consolidate the concrete placed in the forms by vibration or other Acceptable

methods.

608.3.5 Finishing

The Contractor shall finish the surface with a float. The Contractor shall not plaster or re-temper the surface with water. The Contractor shall give the top surfaces of the slabs a transverse broomed finish after floating, unless otherwise specified in the Contract. The Contractor shall use an edging tool with a 1/2 inch radius on the outside edges of the slab and joints.

608.3.5.1 Colored and Patterned Median Pavement Application

The Contractor shall apply the color to the mix at the concrete plant in accordance with the manufacturer's recommendations.

While concrete is still in the plastic state, the Contractor shall apply the imprinting tools to make the desired patterned surface.

The Contractor shall submit a sample panel at least two (2) ft × two (2) ft, showing color and texture, to the Project Manager for approval before starting Work on the patterned concrete pavement. The Contractor shall use the approved sample panel as a standard for the installation of patterned concrete pavement.

608.3.5.2 Joints

The Contractor shall fill the expansion joints with pre-molded expansion joint filler. Also, the Contractor shall fill sealed expansion joints with a backer rod and silicone joint sealant at the specified intervals.

The Contractor shall divide Sidewalks, drive pads, and concrete Median pavement into sections with contraction joints formed with a scoring tool to create rounded edges. The Contractor shall create contraction joints that are approximately 0.125 inch wide and extend into the concrete at least one-third (1/3) the depth of the Sidewalk, drive pad, or concrete Median pavement. The Department will not require contraction joints in patterned concrete Median pavement.

The Contractor shall construct expansion joints that extend into and through the Sidewalk around manholes, pipe inlets, utility poles, or other miscellaneous Structures. The Contractor shall install a pre-molded expansion joint filler to completely fill the joint.

The Contractor shall install expansion joint filler 0.75 inch thick between concrete Sidewalks and fixed Structures, such as buildings or Bridges. The Contractor shall ensure the expansion joint filler extends the full depth of the Sidewalk.

608.3.6 Curing

The Contractor shall cure concrete in accordance with Section 511.3.9, "Curing."

608.3.7 Surface Tolerance

The Contractor shall not allow the surface of concrete Sidewalks and Median pavement to deviate more than 1/4 inch (in any direction), if tested with a ten (10) ft straightedge. The Contractor shall correct deviations at no additional cost to the Department. The Project Manager must approve the correction method.

608.3.8 Detectable Warning Surface

608.3.8.1 Installation Requirements

The Contractor shall install detectable warning surfaces per the manufacturer's recommendations and provide manufacturer's assistance for proper installation when necessary.

The Contractor shall provide the Project Manager the manufacturer's certification stating that the Contractor is certified to install the detectable warning surfaces.

608.3.8.2 Tile Cutting

The Contractor shall provide detectable warning surfaces cut along the flat surface. Cutting along the raised (dome) surface is prohibited.

608.3.8.3 Cleanup

The Contractor shall leave a neat, clean Work area without any contamination. The Contractor shall remove and dispose all waste and excess Material in an environmentally Acceptable manner.

608.4 METHOD OF MEASUREMENT—Reserved

608.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Concrete Sidewalk ___inch</i>	Square Yard
<i>Drive Pad ___inch</i>	Square Yard
<i>Concrete Median Pavement ___inch</i>	Square Yard
<i>Concrete Median Pavement ___inch (Colored)</i>	Square Yard
<i>Concrete Median Pavement ___inch (Colored and Patterned)</i>	Square Yard

608.5.1 Work Included in Payment

The following Work and items will be considered Incidental to the main items:

1. Excavation, backfill, compaction, expansion joint, coloring, and other related items and appurtenances;
2. Bedding Material;
3. All labor, manufacturer field assistance, Materials, Equipment, submittals, repairs, and cleanup; and
4. Detectable warning surface.

SECTION 609: CURB AND GUTTER

609.1 DESCRIPTION

This Work consists of constructing asphalt or concrete curb, concrete gutter, and concrete curb-and-gutter combinations.

609.2 MATERIALS

609.2.1 Concrete

The Contractor shall construct PCC curb and gutter with Class A or Class F concrete in accordance with Section 510, "Portland Cement Concrete." The Contractor shall provide Class A concrete if the concrete is being cast directly into forms and Class F if the concrete is being slip-formed.

609.2.2 Joint Fillers

The Contractor shall provide preformed expansion joint filler in accordance with AASHTO M 33 or AASHTO M 153.

609.2.2.1 Silicone Joint Sealant and Backer Rod

The Contractor shall provide silicone joint sealant and backer rod (bondbreaker) in accordance with Section 452, "Sealing and Resealing Concrete Pavement Joints."

609.2.3 Bed Course Material

The Contractor shall provide bed course Material that consists of cinders, sand, gravel, crushed stone, or other granular aggregate, with 100% passing a 1/2 inch sieve and not more than 12% passing the No. 200 sieve. Alternatively, Base Course as per Section 303, "Base Course" may be used.

609.2.4 Asphalt Material

The Contractor shall provide asphalt Material for curbing in accordance with Section 423, "Hot-Mix Asphalt (HMA) (Major Paving)," and as approved by the Project Manager.

609.3 CONSTRUCTION REQUIREMENTS

609.3.1 Foundation

The Contractor shall place concrete curb and gutter on an approved foundation in accordance with Section 203, "Excavation, Borrow, and Embankment;" Section 207, "Subgrade Preparation;" and Section 303, "Base Course." The Contractor shall prepare the foundation by excavating or constructing Embankment to the specified Subgrade.

609.3.1.1 Excavation

If required, the Contractor shall excavate to the specified depth and compact the base for the curb and gutter in accordance with Section 207, "Subgrade Preparation."

The Contractor shall remove soft and unacceptable Material to two (2) ft below the specified Subgrade and replace with Material having at least the minimum specified design R-value in accordance with Section 203, "Excavation, Borrow, and Embankment," and Section

207, "Subgrade Preparation."

609.3.1.2 Bed Course Placement

For existing ground under bed course, the Contractor shall compact the thickness shown in the Contract to 95% of maximum density in accordance with Section 203.3.7, "Moisture and Density Control."

The Contractor shall compact bed course Material to a density of at least 96% of maximum density in accordance with Section 303.3.2, "Mixing and Placing."

609.3.2 Cast-in-Place Concrete Curb and Gutter

609.3.2.1 Forms

The Contractor shall use wood or metal forms that are straight and free of warps, and constructed to permit the inspection of grade or alignment.

The Contractor shall ensure forms extend the entire depth of the curb and gutter. The Contractor shall brace and secure the forms sufficiently to prevent deflections during concrete placement.

The Contractor shall use flexible forms in curved sections so that the top surface of the forms will produce a smooth, continuous arc.

The Contractor shall treat forms with form release oil to prevent damage to the concrete during form removal. The Contractor shall form the slope of the gutter to match the Roadway cross slope.

609.3.2.2 Mixing and Placing

The Contractor shall thoroughly moisten the bed course immediately before placing the concrete. The Contractor shall not allow standing water on the bed course.

The Contractor shall proportion, mix, and place concrete in accordance with Section 451, "Portland Cement Concrete Pavement," Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures," for the specified class of concrete.

The Contractor shall consolidate the placed concrete in the forms using vibration or other Acceptable methods.

The Contractor shall finish the surface with a float. The Contractor shall not plaster or re-temper the surface with water. Unless otherwise specified, the Contractor shall give the top surfaces of the concrete a transverse broomed finish after floating.

The Contractor shall use an edging tool with a 1/4 inch radius on the outside edges of the curb and gutter and joints.

The Contractor shall leave forms in place until the concrete has set sufficiently to allow removal without damaging the curb and gutter.

609.3.3 Slip-Formed Concrete Curb and Gutter

The Contractor may place curb and gutter using a slip-form machine (except on Structures) if the finished curb and gutter is true to line and grade, and the concrete is dense

and of the specified surface texture.

The Contractor shall construct curb and gutter using a slip-form machine in accordance with Section 451, "Portland Cement Concrete Pavement."

The Contractor shall ensure that the top and face of the finished curb and gutter are true and straight, and the top surface is of uniform width and free from humps, sags, and other irregularities.

The Contractor shall use concrete of a consistency that will maintain the shape of the curb and gutter section without support after slip forming.

The Contractor shall ensure that the forming portion of the slip-form machine is readily adjustable vertically during the forward motion of the machine, to provide a variable height of curb and gutter grade, if necessary.

The Contractor shall attach a grade line gauge or pointer to the slip-form machine so that the Contractor can make a continual comparison between the curb and gutter grades indicated by the gauge or pointer and the offset guidelines.

The Contractor shall feed concrete to the slip-form machine at a uniform rate. The Contractor shall operate the slip-form machine under sufficient uniform restraint from forward motion to produce a well-compacted mass of concrete that is free of surface pits with diameters larger than 0.19 inch, and that requires no further finishing, other than light brushing with a wet brush. The Contractor shall not finish with a brush application of grout.

609.3.4 Joints

The Contractor shall construct curb and gutter in sections with uniform lengths of 30 feet. The Contractor shall separate sections by open joints, 1/8 inch wide, except at expansion joints. The Contractor shall construct contraction joints at intervals of five (5) feet.

The Contractor shall form expansion joints at the intervals in accordance with the Contract, using the preformed expansion joint filler with a thickness of 3/4 inch.

The Contractor shall construct transverse weakened plane and expansion joints at right angles to the line of the concrete curb and gutter.

The Contractor may construct expansion joints by sawing through the concrete curb and gutter section to its full depth. The Contractor shall ensure that the width of the cut Accepts the joint filler with a snug fit.

The Contractor shall complete the operations of sawing and inserting the joint filler before curing the concrete. At the conclusion of the curing period, the Contractor shall check the filler in each joint for tightness. The Contractor shall mortar in place and cure loose filler in joints.

If constructing the curb and gutter adjacent to or on concrete pavement, the Contractor shall locate expansion joints opposite to or at expansion joints in the pavement.

609.3.5 Curing

The Contractor shall cure concrete in accordance with Section 511.3.9, "Curing."

609.3.6 Backfilling

After the concrete attains a compressive strength of 2,500 psi, the Contractor shall fill the spaces in back of the curb to the specified elevation with Embankment Material, and compact in accordance with Section 203.3.7, "Moisture and Density Control," unless otherwise specified in the Contract.

609.3.7 Asphalt Curbing

If constructing asphalt curbing on an asphalt surface, the Contractor shall place the curb after cleaning the surface and applying a tack coat of asphalt Material.

The Project Manager will determine the tack coat application rate. The Contractor shall construct asphalt curbing using a paver with curbing attachments.

609.4 METHOD OF MEASUREMENT

The Department will measure curb along the front face of the section.

The Department will measure gutter and curb-and-gutter combinations along the flowline of the gutter.

609.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Concrete Curb ___ inch</i>	Linear Foot
<i>Bituminous Curb</i>	Linear Foot
<i>Header Curb</i>	Linear Foot
<i>Concrete Sloped Curb and Gutter ___ inch x ___ inch</i>	Linear Foot
<i>Concrete Vertical Curb and Gutter Type ___, ___ inch x ___ inch</i>	Linear Foot
<i>Standard Curb and Gutter</i>	Linear Foot
<i>Concrete Valley Gutter ___ inch x ___ inch</i>	Linear Foot
<i>Concrete Laydown Curb ___ inch</i>	Linear Foot

609.5.1 Work Included in Payment

The following Work Included in payment will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Excavation, borrow, bed course, compaction and Embankment;
2. For foundation of curb and gutter, expansion joint Material (including silicone joint sealant and backer rod), coloring, and other related items and appurtenances; and
3. Backfilling behind curb and reflectorized yellow paint for Median curb and gutter from radius point to radius point on the bull nose portion.

SECTION 610: CATTLE GUARDS

610.1 DESCRIPTION

This Work consists of constructing precast concrete cattle guards or steel frame cattle guards.

610.2 MATERIALS

610.2.1 General

The Contractor shall provide cattle guards and grids in accordance with the Contract. The Contractor shall provide individual cattle guards with grids of identical type having the same shapes, dimensions, and weight of the steel members.

The Contractor shall use steel frame cattle guards as an alternate to precast concrete cattle guards at turnouts or at other locations in accordance with the Contract.

The Contractor shall permanently cap all vertical metal pipes.

If the Contract specifies precast concrete cattle guards, the Department will not allow substitutions.

610.2.2 Precast Concrete Cattle Guards

The Contractor shall use Class AA concrete in accordance with Section 510, "Portland Cement Concrete."

The Department will reject cattle guards with cracks, chips, spalls, or honeycombed or patched areas in excess of 30 in²; or those that fail to meet the minimum strength requirements.

The Contractor shall provide shop drawings in accordance with Section 105.2, "Plans and Working Drawings" of the New Mexico State Department of Transportation Standard Specifications for Highway and Bridge Construction Current Edition, and in accordance with the current edition of the ACI Detailing Manual.

The Contractor shall fabricate precast concrete cattle guard steel grids and other steel appurtenances in accordance with Section 541, "Steel Structures."

610.2.3 Steel Frame Cattle Guards

The Contractor shall provide steel frame cattle guards from approved manufacturers listed on the Department's *Approved Products List*.

610.2.4 Reinforcing Steel

The Contractor shall use Grade 60 reinforcing steel deformed bars in accordance with Section 540, "Steel Reinforcement."

The Contractor shall provide welded wire fabric in accordance with AASHTO M 55.

610.2.5 Cattle Guard Grids and Hardware

The Contractor shall provide traffic grill units, warning devices, bolts, tie bolts washers,

hardware, and other Materials in accordance with Section 541, "Steel Structures."

The Contractor shall provide grid units in accordance with AASHTO M 183.

The Contractor shall provide aluminum members in warning devices in accordance with the ASTM Specifications listed in Table 610.2.5:1, "Aluminum Members Warning Devices Standards."

**Table 610.2.5:1
Aluminum Members Warning Devices Standards**

Description	ASTM	Alloy	Temper
Tubing	B 429	6061	T-6
Fence angle	B 221	6061	T-6
Base plate	B 209	6061	T-6

610.3 CONSTRUCTION REQUIREMENTS

610.3.1 Concrete Footings and Foundations

The Contractor shall excavate or build with Embankment, level, and compact foundations for cattle guards before installing the cattle guard. The Contractor shall excavate wide enough to compact and test Material adjacent to the cattle guard, or backfill with flowable fill at no extra cost to the Department.

The Contractor shall finish uneven foundation surfaces to ensure full bearing of cattle guard units. The Contractor shall compact Subgrade foundations in accordance with Section 207, "Subgrade Preparation."

If the Contractor finds unstable Material in footing foundations, the Contractor shall stabilize, or remove and replace with Material approved by the Project Manager.

The Contractor shall place a three (3) inches thick bedding of fine aggregate over the Subgrade and compact it to at least 95% of the maximum density in accordance with AASHTO T 180 (Modified Proctor), Method D (TTCP Modified). The Contractor shall place the cattle guard unit on the fine aggregate bedding.

The Contractor shall finish the tops of concrete footings so that stringer-bearing surfaces receive the full bearing under each stringer.

610.3.2 Placement Requirements

The Contractor shall place the concrete cattle guards in accordance with Section 511, "Concrete Structures." The Contractor may splice reinforcing bars over 30 ft long using a minimum 24-bar diameter lap.

The Contractor shall chamfer exposed edges of concrete $\frac{3}{4}$ inch.

The Contractor may use used steel members that are free of bends and in good condition, as approved by the Project Manager.

The Contractor shall fabricate grids so that the bottoms of the stringers are in a plane surface.

610.3.3 Protective Coating

The Contractor shall provide cattle guards with a protective coating in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

The Contractor shall stripe warning devices with two (2) coats of black coating Material in accordance with the Contract.

610.3.4 Backfill

The Contractor shall perform the excavation, placement, and compaction of select backfill in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

610.4 METHOD OF MEASUREMENT—Reserved

610.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Cattle Guard (____ ft)</i>	Each

610.5.1 Substitutions

The Department will not adjust the Bid price for weights of rails greater than the specified minimum.

610.5.2 Work Included in Payment

The following Work and items, except when otherwise specified, will be considered as included in the payment for the main items, complete in place as detailed in the Contract, and will not be measured or paid for separately:

1. Subgrade preparation, excavation, replacement of unstable Subgrade, placement and compaction of select backfill;
2. All steel reinforcement (Including welded wire fabric);
3. All Structural Steel, bearing pads, all connecting hardware and associated components; and
4. All warning devices, all field painting, and all appurtenances necessary to complete the Work.

SECTION 613: CLEANING OF CULVERTS AND DRAINAGE STRUCTURES

613.1 DESCRIPTION

This Work consists of removing unsuitable Material from within and around concrete box Culverts, concrete Culverts, corrugated metal Culverts, storm drains, catch basins, inlets, and outlets.

613.2 MATERIALS—RESERVED

613.3 CONSTRUCTION REQUIREMENTS

Before beginning Structure extension Work, the Contractor shall clean the existing Structures that will remain operational.

The Contractor shall remove Materials on the Roads and Streets that accumulate during the performance of the Work.

The Contractor shall clean ditch lines within the Right of Way to prevent ponding and ensure proper drainage.

613.3.1 Equipment

If using a mechanical jet rodding machine in cleaning operations, the Contractor shall provide water necessary to complete the Work.

613.3.2 Disposal Requirements

The Contractor shall haul the debris and unsuitable Material to an environmentally suitable disposal site.

The Contractor shall obtain the permits and clearances from the appropriate regulatory agencies in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public."

The Contractor shall notify the Project Manager in writing of the details prior to disposal operations.

The Contractor shall not place rock waste, vegetative debris, or any other debris in wetland areas or areas that may impact endangered species or archaeological resources. The Contractor shall obtain an archaeological survey and environmental clearance for approval of the disposal sites.

613.3.3 Traffic Control Requirements

The Contractor shall provide, install, and maintain traffic control devices necessary to protect the Work and the safety of the public in accordance with most current Edition of MUTCD.

613.3.4 Final Acceptance

The Contractor shall clean the Project site before the Final Acceptance.

613.4 METHOD OF MEASUREMENT

The Department will only measure *Cleaning Culverts and Drainage Structures* if specified as a pay item in the Contract.

613.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Cleaning Culverts and Drainage Structures</i>	Lump Sum

613.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Water for cleaning;
2. Furnishing, installing and maintaining traffic control devices;
3. Hauling and disposal of waste and debris; and
4. Cleaning of ditch lines within Right of Way.

SECTION 614: PIPE CASING

614.1 DESCRIPTION

This Work consists of providing and installing pipe for encasing utility lines.

614.2 MATERIALS

614.2.1 Galvanized Steel Pipe

The Contractor shall provide galvanized steel pipe in accordance with ASTM F 1083 for galvanized standard weight pipe.

614.2.2 Corrugated Steel Pipe

The Contractor shall provide corrugated steel pipe in accordance with AASHTO M 36 and Section 570, "Pipe Culverts."

614.2.3 Polyvinyl Chloride Pipe

The Contractor shall provide polyvinyl chloride pipe in accordance with Section 570, "Pipe Culverts."

614.3 CONSTRUCTION REQUIREMENTS

The Contractor shall obtain Project Manager approval of the installation method before beginning the Work. The Contractor shall dig trenches for laying pipe in accordance with Section 660.3.1.1, "Trench Widths." The Contractor shall connect the pipe sections in accordance with the manufacturer's recommendations. The Contractor shall backfill the trenches in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

614.4 METHOD OF MEASUREMENT—RESERVED

614.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Pipe Casing</i>	Linear Foot

614.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. All appurtenances necessary to attach pipe casing to Bridge or Structures; and
2. No separate payment shall be made for excavation and backfill for pipe casing.

SECTION 617: VIBRATION MONITORING AND VIDEO RECORDING

617.1 DESCRIPTION

The Contractor shall perform vibration monitoring and video recording in and around all engineered Structures, sensitive features and construction areas as indicated in the Contract and as determined by the vibration risk survey, or as directed by the Project Manager. Sensitive features may include archaeological sites, historical features, utilities, and historic Structures, watercourses and other areas subject to damage or erosion.

The Contractor shall perform vibration monitoring and video recording to determine if potentially damaging vibrations to engineered Structures and sensitive features are created as a result of construction activity.

617.2 MATERIALS – RESERVED

617.3 CONSTRUCTION REQUIREMENTS

617.3.1 General

617.3.1.1 Vibration Monitoring

Vibration monitoring consists of the following:

1. Vibration risk survey of all sensitive features within the influence zone of construction activity to determine size and locations of any existing cracks and other defects in any sensitive features;
2. Use of a seismograph, by a qualified vibration specialist, to monitor vibration levels; and
3. Immediate notification of the Project Manager, if visual inspection or seismograph readings indicate that damage to any sensitive feature is occurring due to vibrations.

617.3.1.2 Video Recording

Video Recording consists of the following:

1. Video recording in both directions along the Roadway corridor and along Roadways to be constructed or reconstructed. Insure that these video recordings pick up existing utilities within the corridor as well as existing drainage patterns. The maximum speed of camera movement shall not exceed four (4) ft/s;
2. Pre-Construction video recording for each area on the Project shall take place not more than fourteen (14) Days prior to beginning construction in that area or as directed by the Project Manager;
3. During all video recording, provide an audio explanation of significant features observed during recording;
4. Any notification of any damage or any concerns/remedies resulting from construction activities shall be immediately relayed to the Project Manager;
5. Video record building Structure front and side views, including close-ups of each view, for any features or facilities that may be affected by construction. Where cracks exist on building Structures place a scale next to the crack and video record to show existing crack size. Such building features may include, but are not limited to, all buildings, fences and landscaping adjacent to the Project limits;
6. Video record the construction area immediately following rainfall over the area to ascertain drainage patterns. This video recording shall take place before

- commencing construction when possible;
7. Video recording Equipment and operator shall be onsite within ½ hr at the Project Manager's request;
 8. The video viewing system and the appropriate video recordings shall be available for meetings as scheduled, and at the request of the Project Manager; and
 9. The quality of the visual and audio portions of the video recordings, and the method of indexing of locations on the recordings, shall be Acceptable to the Project Manager. Recordings or portions of recordings deemed defective or substandard shall be re-recorded.

617.3.2 Condition Survey of Engineered Structures and Sensitive Features

The Contractor shall conduct a vibration risk survey of any sensitive features within the influence zone of construction activity.

1. The Contractor shall submit to the Project Manager, a report documenting conditions of all potentially affected sensitive features within the survey influence zone or as shown in the Contract; and
2. The Contractor shall include the following information from the survey, for each sensitive feature:
 - 2.1 The age, foundation, and above-ground Structure type or sensitive feature;
 - 2.2 Provisions for water drainage from roof and around foundation exterior;
 - 2.3 The age, type, and condition of any sensitive utility; and
 - 2.4 Documentation (in the form of drawing, photographs, or video recordings) of the size and location of all cracks, and the type and location of all structural defects.

617.3.3 Equipment

617.3.3.1 Seismograph Equipment

The Contractor shall provide seismograph(s) with self-triggering unit(s), approved by the Project Manager, and capable of recording three (3) mutually perpendicular components of ground motion time histories, in terms of velocity. In the case of monitoring blast vibrations, the Contractor shall provide additional capability for recording of airblast levels. The Contractor shall provide unit(s) capable of reporting the frequency as well as the peak values for all vibration time histories.

617.3.3.2 Video Camera Equipment

The Contractor shall furnish at least one (1) video camera and appurtenances for the duration of the Project. The Equipment shall be capable of producing a color picture when the recording is viewed, equipped with audio capabilities; and equipped with a zoom lens.

The Contractor shall furnish at least one (1) video recording viewing system and appurtenances for the duration of the Project. The Equipment shall be capable of reproducing a color picture with audio on a television screen; and capable of slow motion, stop for viewing of single picture image, and reverse controls.

The Contractor shall supply a sufficient number of two (2) hour videos to videorecord the entire construction area and adjacent areas before construction commences, and as required or directed by the Project Manager during and after construction. Each videorecording shall

be titled, catalogued, dated, sequenced in chronological order, and cross-referenced. A copy of each two (2) hour videorecording shall be submitted to the Project Manager. This copy shall also be titled, catalogued, dated, sequenced, and cross-referenced; and will remain the property of the Department upon Acceptance by the Project Manager.

617.3.4 Seismograph Location and Usage

The Contractor shall place seismographs outside the sensitive features closest to the construction activity as determined by the vibration risk survey or approved by the Project Manager. The transducer(s) shall be placed between the construction and the sensitive features and coupled to the ground.

617.3.5 Frequency of Vibration Monitoring

For all construction activity other than blasting, the Contractor shall perform monitoring at least two (2) times during peak construction when construction activity is occurring near the sensitive features, and at the Project Manager's request.

617.3.6 Qualification for Vibration Monitoring

The Contractor shall provide a qualified specialist competent to perform the Work and analyze the results of vibration monitoring. Department approved specialist are on file with the Department's Geotechnical Section.

617.3.7 Prior Experience

The Contractor shall submit the following written documentation of prior experience to the Project Manager:

1. Copies of reports including analysis and conclusions for at least three (3) previous Projects similar in scope to this Project; and
2. Resumes for all personnel involved in this Work.

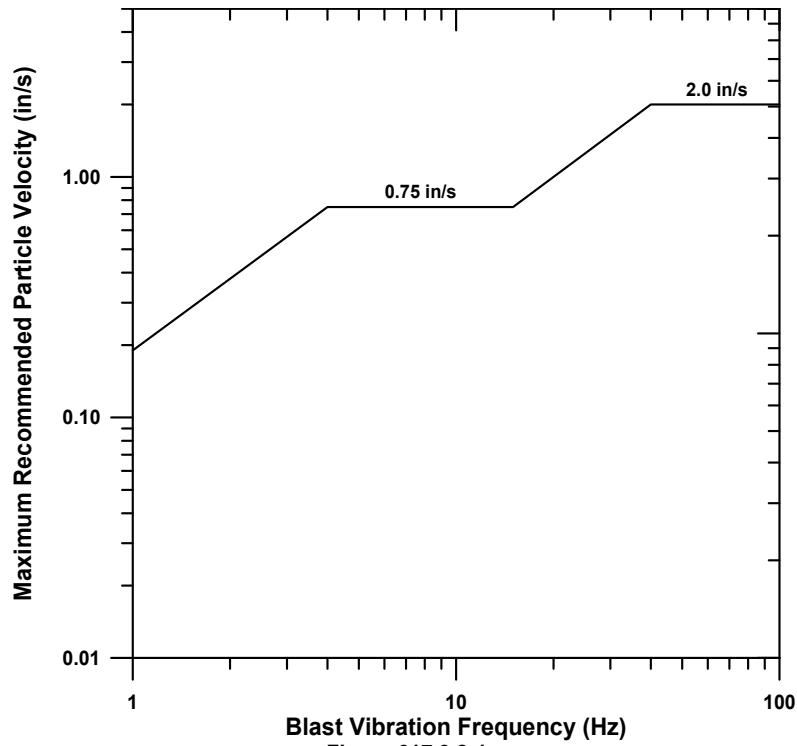
617.3.8 Analysis of Vibration Monitoring

The Contractor shall submit to the Project Manager eight (8) copies of a comprehensive report for each sensitive feature. Each report shall include a discussion of:

1. Site conditions and description, including a site map drawn to scale showing the location of the sensitive feature and the location of the construction activity;
2. Field procedures and Equipment used, including the seismograph manufacturer, model and unit serial number;
3. The name of the seismograph operator;
4. A hard copy of all ground vibration time histories, in units of velocity;
5. A record summary of the maximum value of ground vibration in any one (1) of three (3) directions measured (longitudinal, radial, or vertical), the frequency associated with the maximum value, in unit of hertz, and the measured distance between the seismograph and the construction activity;
6. Analysis of results with conclusions and recommendations; In the case of blasting, the report shall also include:
 - a. A hard copy of the airblast time history, in units of decibels and pounds per square inch (psi), the maximum value of airblast, in decibels, and the peak airblast frequency in hertz;

- b. The maximum charge weight of explosive used per eight (8) millisecond time Delay;
- c. The scaled distance factor used for design; and
- d. A plot of the ground motion velocity plotted against frequency for the maximum values recorded on a graph similar to that shown in Figure 617.3.8:1.

The Contractor shall submit any additional inclusions to the report(s) at the direction and request of the Project Manager.



617.3.9 Safe Vibration Levels for Blasting

The Contractor shall base safe levels of the maximum ground motions and air blast in accordance with nationally recognized standards specified by the U.S. Bureau of Mines 30 CFR Parts 715 and 817.

617.4 METHOD OF MEASUREMENT

Vibration Monitoring will be measured as a Lump sum unit.

Vibration Risk Survey will be measured as a Lump sum unit.

617.5 BASIS OF PAYMENT

Pay Item

Vibration Monitoring
Vibration Risk Survey
Video Recording

Pay Unit

Lump Sum
Lump Sum
Lump Sum

SECTION 618: TRAFFIC CONTROL MANAGEMENT

618.1 DESCRIPTION

This Work consists of providing traffic control management in accordance with the Contract and the *MUTCD, current edition*, including supervision of personnel and installation, inspection, maintenance and field adjustment of traffic control devices on the Project.

618.2 REQUIREMENTS

The Contractor may assign more than one (1) traffic control supervisor (TCS) to provide traffic control management for the Project.

If assigning more than one (1) TCS to provide traffic control management, the Contractor shall submit to the Project Manager a weekly schedule identifying who shall be in charge of providing traffic control management each Day.

The Contractor shall provide the TCS with a set of traffic control Plans and a current copy of the *MUTCD*. The TCS shall possess these at all times.

If using a Subcontractor to provide traffic control management, the Contractor shall ensure that the TCS is in accordance with the Contract.

The Contractor may assign one (1) or more traffic control technician (TCT) to assist the TCS in inspection and maintenance of traffic control devices.

All Equipment, Materials, and/or vehicles stored within the ROW shall be outside of the clear zone as denoted in the Contract or per the AASHTO Roadside Design Guide (current version).

618.2.1 Certification

Before commencing Work that requires traffic control management, the Contractor shall submit to the Project Manager a copy of the "Work Zone Safety Supervisor" certificate for the TCS (wallet size card) issued by the American Traffic Safety Services Association (ATSSA), the Associated Contractors of New Mexico (ACNM), or an agency or firm approved by the Department.

Wallet size card or proof of certification shall be on the individual in the field while on the Project.

The Department will Accept the TCS certification by ATSSA, ACNM, or any agency or firm only if the following requirements are met:

1. Successful completion of a Department-approved Work-zone traffic control course;
2. Passing a written examination on a Work-zone traffic control course; and
3. At least one (1) year of full-time field experience, verified by the agency or firm, in Work zone traffic control; the Department may verify the experience at its discretion.

The TCT must only satisfy requirements 1 and 2, above.

Before commencing Work that requires flagger traffic control, the Contractor shall submit a copy of the "Flagger Training" certificate (wallet sized card) issued by ATSSA, ACNM, FHWA, or an agency or firm approved by the Department.

618.2.1.1 Re-certification

The Contractor shall renew the TCS's certification every four (4) years through the ATSSA, ACNM, or a Department-approved agency or firm.

The Contractor shall re-certify in the fourth year, before the expiration date of the current certification.

Flaggers must obtain refresher training which meets the requirements of ATSSA, ACNM, FHWA, or agency or firm approved by the Department prior to the fourth anniversary date shown on the current certificate.

618.2.2 Duties

The TCS's only responsibility is traffic control management. The Department may allow exceptions to this rule if the Project is small and requires limited traffic control. The Project Manager and the District Traffic Engineer will determine approval of the exception at the Pre-Construction Conference.

The TCS's primary duties include the following:

1. Providing management and supervision services at the Project site;
2. Preparing revisions requested by the Contractor to the traffic control Plan in the Contract and submitting the new traffic control Plan, in CAD format or hand drafted on a 12 inch × 18 inch piece of 20-pound paper using current drafting standards, to the Project Manager for approval by the District Traffic Engineer. Complex traffic control Plans require development by a registered professional Engineer prior to submittal to the Project Manager;
3. Coordinating the flagging and signing personnel training;
4. Supervising the flagging and signing personnel;
5. Coordinating traffic control operations for the duration of the Contract, including those of Subcontractors, utility companies, and Suppliers, to ensure that traffic control is in place and fully operational before the commencement of Work. When dealing with utility companies, the TCS shall coordinate concurrent utility traffic control with other construction traffic control to avoid conflicts;
6. Coordinating, in writing, Project activities with the appropriate individual traffic control, law enforcement, and fire control agencies;
7. Preparing and submitting statements concerning Road closures, Delays, and other Project activities to the news media, as necessary. Before submittal to the news media, the Contractor shall submit news releases to the Project Manager for review and approval;
8. Notifying the Project Manager of accidents related to the Project traffic control;
9. Recording time and date of accident notification in accordance with Section 618.2.2.1, "Traffic Control Diary;"
10. Attending the Pre-Construction Conference;
11. Maintaining, cleaning, and replacing traffic control devices in use per the current traffic control Plan during working and non-working hours; and
12. Throughout the Construction duration for Projects the Contractor shall be responsible to keep the Project Manager and the District Public Relations Officer informed of any information regarding construction activities.

618.2.2.1 Traffic Control Diary

The TCS shall maintain a Project traffic control diary in a bound book. The Contractor shall obtain the diary from the ACNM.

The TCS shall keep the traffic control diary current each Day and sign each daily entry.

The TCS shall make entries in ink, in a format approved by the Project Manager, without erasures or white-outs. The TCS shall strike out unacceptable entries and replace with Acceptable ones. The TCS may use photographs to supplement the written text.

The Contractor shall ensure that the traffic control diary is available for inspection by the Project Manager at all times and submit a copy of the diary to the Project Manager at the end of each week. Incident reports will be made available to the Project Manager upon request.

The traffic control diary will become the property of the Department at the completion of the Project. If the Contractor fails to submit the diary, the Department may withhold final payment until it is submitted.

618.2.2.2 Inspection of Traffic Control

The Contractor shall keep all traffic control equipment clean and in good repair. The TCS shall inspect traffic control devices every Day that traffic control devices are in use. The TCS shall provide for the immediate cleaning, repair, or replacement of traffic control devices that are not functioning as required to ensure the safety of the motorists and construction personnel.

The TCS shall conduct inspections of the traffic control devices at the beginning and end of each Day that traffic control devices are in use, and as scheduled or directed by the Project Manager during the Work Day.

The TCS shall inspect the traffic control devices during working and non-working hours on a schedule approved in writing by the Project Manager.

The TCS shall inspect traffic control devices that are in use for longer than seven (7) Days at least once a week during nighttime periods.

618.2.3 Availability of TCS

The Contractor shall provide traffic control management under the supervision and direction of the TCS on a 24-hour-per-Day basis throughout the duration of the Project, the TCS shall be on the Project whenever Work is in progress, and available by telephone to be on the Project within one (1) hour at all times.

The provisions for availability of the TCS will also apply during times of Partial or full Project Suspension.

618.2.4 Signal Coordination and Operation

The Contractor shall be required to develop and maintain alternate traffic signal timing Plans within the Work zone and along detour routes and route affected by long-term closures temporary traffic control as defined in the Contract lasting longer than five (5) Calendar Days. The Work shall conform to the following process, and shall be developed and stamped by a licensed Professional Engineer in the State of New Mexico:

1. Prior to the start of construction, the Contractor shall schedule a coordination

- meeting with the local agency responsible for maintaining the affected traffic signals;
2. Collect traffic count data at affected intersections. Collection procedure may use either mechanical equipment or staff;
 3. Estimate addition or subtraction of vehicles based on change in traffic patterns due to Project;
 4. New volume data shall be entered into a signal timing software for development of new Plans. Whenever possible, those Plans shall coordinate with the local agency timing plans through the use of identical cycle lengths;
 5. Where the local agency maintains control of the signal throughout construction, new timing plans shall be delivered to local agency staff one (1) week before anticipated implementation;
 6. Where the Contractor constructs a new traffic signal, either temporary or permanent, the Contractor shall ensure that the new timing Plan is entered into the signal controller prior to the first Day of the construction phase; and
 7. After notification is received that the new Plans have been implemented, Contractor staff shall verify that the new Plan is working within desired parameters.

618.3 COMPLIANCE

618.3.1 Failure to Comply

If the Contractor fails to comply with the approved traffic control Plan or fails to immediately correct unsafe traffic conditions after written notification of the problem, the Project Manager may suspend all or part of the Contractor's operations.

If the Contractor does not take appropriate action to correct the problem, the Department may proceed with the corrective action and charge the Contractor for the additional cost incurred by the Department.

If the Department suspends the Contractor's operations, the Department will include the period necessary to correct these unsafe conditions and traffic control deficiencies in the normal assessment of Contract Time.

The Department will not relieve the Contractor of the responsibility to provide traffic control safety to the traveling public, if the Department fully or Partially Suspends the Project.

If the Department suspends the Project due to the Contractor's failure to comply with this Section, or the Contract is in liquidated damages, the Contractor shall continue to provide traffic control management, at no additional cost to the Department.

If the Contractor requests full or Partial Suspensions, the Contractor shall perform the additional traffic control management at no additional cost to the Department.

The Contractor shall reimburse the Department for the Department's incurred costs of such corrections plus an additional ten percent (10%) for administrative costs.

618.3.2 Project Manager Modifications

The Project Manager may change requirements for handling and controlling traffic during construction, with the approval of the District Traffic Engineer, due to actual field conditions. The Project Manager will make these changes and provide written notice to the Contractor.

618.4 METHOD OF MEASUREMENT—Reserved

618.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Traffic Control Management</i>	Lump Sum
<i>Traffic Control Management</i>	Calendar Day

618.5.1 Partial Payments

If the Department pays for *Traffic Control Management* by the Lump sum, the Department will make monthly partial payments for *Traffic Control Management* based on the rate of progress of the Project, less previous partial payments for this item. The Department will calculate partial payments in accordance with the following equation:

$$P = \left(\frac{A \times L}{B} \right) - C \quad (1)$$

Where,

P is the partial payment

L is the Total Bid Amount for *Traffic Control Management*

A is the number of Days charged the Contractor toward completion of the Project

B is the original Contract Time

C is the total amount of previous partial payments for this item

The Department will negotiate payment for additional traffic control management resulting from an increase in Work beyond the scope of the Project. The Contractor shall not start Work until agreement on payment for additional *Traffic Control Management*.

For normal increases in Contract Items resulting in extensions of the Contract Time, the Department will increase the original Lump sum amount based on the ratio of actual additional Days used to the original Contract Time.

SECTION 619: HEADGATES AND FLAPGATES FOR IRRIGATION DITCHES

619.1 DESCRIPTION

This Work consists of providing, installing, and repairing headgates, flapgates, and appurtenances, and, if specified, constructing irrigation ditches.

619.2 MATERIALS

The Contractor shall provide headgates, flapgates, and appurtenances in accordance with the Contract. The Contractor shall provide reinforcement for concrete headwalls in accordance with Section 540, "Steel Reinforcement," and concrete in accordance with Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures."

619.3 CONSTRUCTION REQUIREMENTS

The Contractor shall construct irrigation ditches in accordance with Section 203, "Excavation, Borrow, and Embankment."

The Contractor shall install headgates and flapgates in accordance with the Plans.

The Contractor shall compact backfill in contact with the Structure to prevent leakage of water and erosion.

619.3.1 Protective Coating

The Contractor shall provide headgates and flapgates with a protective coating in accordance with the manufacturer's recommendations. If headgates and flapgates are uncoated, the Contractor shall coat non-contact surfaces in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

619.4 METHOD OF MEASUREMENT—Reserved

619.5 BASIS OF PAYMENT

Pay Item	Pay Unit
Headgate Type ____, __ inch	Each
Flapgate __ inch	Each

619.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Protective coating of headgates and flapgates,
2. Concrete, and
3. Steel reinforcement.

SECTION 620: SELECTIVE/NON-SELECTIVE HERBICIDE APPLICATION

620.1 DESCRIPTION

This Work consists of providing and applying herbicide.

The Contractor shall store, handle, mix, and apply all herbicide in accordance with the manufacturer's label, EPA, NMDA rules and regulations.

620.2 MATERIALS

The Contractor shall provide herbicide in accordance with the Contract.

620.3 CONSTRUCTION REQUIREMENTS

620.3.1 Handling, Mixing, and Loading Herbicides

The Contractor shall keep livestock, pets, and persons away from mixing and loading areas. When mixing herbicide, the Contractor shall provide a well-ventilated mixing area away from perennial or ephemeral waterways to avoid contamination. The Contractor shall follow the instructions and warnings on the manufacturer's labels during mixing, loading, and application of herbicides, to protect against spills, splash, and wind-drift. The Contractor shall wear Personal Protective Equipment in accordance with the manufacturer's label.

620.3.2 Storage of Herbicides

The Contractor shall store herbicides in accordance with the applicable manufacturer's label and other rules and regulations.

620.3.3 Labeling Information

The Department will designate chemicals proposed for treatment. The Contractor shall provide the following information to the Department 14 Days before using the chemicals:

1. Appropriate specimen labels;
2. MSDSs;
3. Technical bulletins;
4. Toxicity ratings; and
5. EPA registration numbers.

620.3.4 Laws and Regulations

The Contractor shall strictly adhere to laws regulating the storage, handling, mixing, loading, transporting, spill and accident reporting, and use of herbicides.

620.3.4.1 Minor Spills

The Contractor shall isolate the spill area and keep unauthorized personnel away. The Contractor shall use soil, sawdust, or other absorbent Material to soak up the spill. The Contractor shall place contaminated Material into a leak-proof container and dispose of in accordance with applicable laws and regulations.

620.3.4.2 Major Spills

The Contractor shall keep unauthorized personnel away, confine the area, and administer first aid if needed. The Contractor shall notify the Chemical Transportation Emergency Center (Chemtrec), the local fire department and police, and State herbicide authorities for assistance. If a major spill occurs on a State Highway, County Road, or City Street, the Contractor is responsible for notifying the affected State and local agencies. If food or water is contaminated, the Contractor shall notify State or federal food and drug authorities and regional, State, and federal air quality or water pollution authorities.

620.3.5 Certification of Applicators

The Department will only allow the Contractor to apply herbicides under the direct supervision of an appropriately licensed and certified applicator. The Department requires the Contractor or its subcontractor to be licensed in New Mexico as a commercial applicator in accordance with NMDA requirements, and certified in appropriate applications. The Department will verify proper training and testing for competency in the safe and effective handling and use of herbicides. The Contractor shall provide proof of license through the NMDA to the Project Manager 14 Days before the application of the herbicide.

620.3.6 Safety Guidelines

The Contractor shall adhere to the safety guidelines on the Manufacturer's label regarding the following:

1. Potential hazards to humans, domestic animals, and the environment;
2. Physical and chemical hazards such as fire, explosion, or chemical reactions to other products; and
3. Herbicide use, misuse, storage, and disposal.

The Contractor shall not apply herbicide on frozen ground. The Contractor shall not spray along and across irrigation ditches where damage to private property could occur. If within the limits of a Town or City, the Contractor shall spray in accordance with local ordinances. The Contractor shall not spray if the wind speed exceeds ten (10) mph, unless stated otherwise on the chemical label.

The Contractor shall apply herbicide to both sides of the Roadway to control noxious weeds, as directed by the Department. The Department will specify the spray width and exact beginning and ending points at the time of application.

The Department reserves the right to reject Equipment on the basis of suitability and safety to the environment, the traveling public, the Contractor's employees, and Department employees. The Contractor shall provide Equipment in accordance with OSHA, the U.S. Department of Transportation, and the NMDA.

The Contractor shall ensure that each spray truck is properly licensed and carries the appropriate plaques as required by State law.

620.3.7 Records and Documentation

The Contractor shall supply a current copy of the license and applicator's certification to the Project Manager for verification by the Department's Roadside Vegetation Management Unit. The Contractor shall keep a daily record of the herbicide application showing the following information:

1. Date of application;
2. Types and application rates of herbicides applied;

3. Time of Day of application;
4. Air temperature;
5. Wind velocity;
6. Area covered;
7. Location of areas treated; and
8. Equipment calibration information.

The Department will verify the Contractor's daily record. The Contractor shall submit copies of the records to the Project Manager within 14 Days of the spraying.

620.3.8 Equipment

620.3.8.1 Equipment Calibration

The Contractor shall calibrate the Equipment to apply the proper amount of liquid per unit area in accordance with the chemical manufacturer's label before introducing chemicals into the Equipment. The Contractor shall recalibrate the Equipment in accordance with manufacturers recommendations and as required by the Project Manager.

620.3.8.2 Hand-Held Spray Applicators

The Department will allow the Contractor to use backpack or hand-held power Equipment in inaccessible areas, including cracks in Medians or islands, around guardrail posts, and signposts. The Contractor shall use hand-held applicators as directed by the Project Manager.

620.3.8.3 Broadcast Sprayers

The Contractor shall apply herbicides with Equipment that has a spray bar with sufficient width and number of nozzles to provide uniform application rates in accordance with the manufacturer's label. The Contractor shall ensure the spray bar is adjustable to varying widths and heights to properly distribute the herbicide, to minimize drift, and to apply herbicides to specified areas only.

620.3.8.4 Boomless Sprayers

The Contractor shall not use boomless spraying Equipment for herbicide application, unless otherwise specified in the Contract or directed by the Project Manager. If specified or directed, the Contractor shall ensure that boom sprayers are capable of applying the herbicide to widths in accordance with the Plans and at rates in accordance with the manufacturer's label. The Contractor shall use a drift control agent with boom sprayers in accordance with the manufacturer's recommendations.

620.3.8.5 Sprayer Parts

620.3.8.5.1 Tanks

The Contractor shall use tanks for herbicide applications with large openings for easy filling and cleaning and that have a gauge to show the liquid level. The Contractor shall equip tanks with a shut-off valve for storing liquid herbicide temporarily while the Contractor services other sprayer parts.

620.3.8.5.2 Agitators

The Contractor shall equip spray Equipment with hydraulic jet agitators of sufficient size and number to keep the chemical adequately agitated in accordance with the manufacturer's label.

620.3.8.5.3 Strainers

The Contractor shall equip herbicide sprayers with strainers to prevent clogging of spray nozzles and to protect the working parts of the sprayer. The Contractor shall clean strainers at least daily, or as specified, and replace if damaged.

620.3.8.5.4 Pressure Gauges

The Contractor shall equip sprayers with a pressure regulator to control the pressure and the quantities of herbicide liquid delivered by the nozzles, and protect other sprayer parts from damage due to excessive pressure.

620.3.8.5.5 Pumps

The Contractor shall use spraying Equipment with a pump capable of supplying the required volume to the spray nozzles. The Contractor shall ensure that pump parts resist corrosion and abrasion if using abrasive Materials such as wettable powders. The Contractor shall use spraying Equipment with gaskets, plunger caps, and impellers that resist swelling and chemical breakdown caused by liquid herbicides.

620.3.8.5.6 Nozzles

The Contractor shall use nozzles of the design and type that provide the proper spray pattern and uniformly distribute the herbicide mixture over the specified areas. The Contractor shall use nozzles composed of the following major components:

1. Nozzle body;
2. Cap;
3. Filter; and
4. Tip or orifice plate.

The Contractor shall check nozzles for clogging, as necessary, and maintain them to ensure proper operation of the sprayer. The Contractor shall use drift-control spot-spraying nozzles.

620.3.8.5.7 Hoses and Fittings

The Contractor shall use hoses in accordance with the following:

1. Made of neoprene, rubber, or plastic Material having a burst strength greater than the maximum operating pressure;
2. Resistant to oil and other solvents present in herbicides; and
3. Weather resistant.

The Contractor shall not use PVC hoses or fittings.

620.3.8.6 Cleaning of Equipment

The Contractor shall ensure that sprayers are in good condition and have no leaks while

standing, mixing, or spraying. The Contractor shall not leave spraying Equipment at the application site. The Contractor shall clean the spraying Equipment before arrival at the site. The Contractor shall rinse mixing Equipment into the sprayer tank after each use and before topping off the tank. The Contractor shall not clean the Equipment at the site.

620.3.9 Disposal

620.3.9.1 Disposal of Excess Herbicides

When calibrating the Equipment, the Contractor shall not allow chemical solutions to accumulate. Unmixed concentrated chemicals remain the property of the Contractor. The Contractor shall exercise care with unmixed concentrated chemicals, including those in unopened containers.

620.3.9.2 Disposal of Containers

The Contractor shall dispose of empty containers in accordance with NMDA guidelines.

620.3.10 Samples and Inspection

The Contractor shall provide tank samples at the request of the Department. The Department reserves the right to inspect the tank mix and Equipment before, during, or after the spraying process. Quality assurance inspections are required before any payment.

620.4 METHOD OF MEASUREMENT

The Department will measure *Selective/Non-Selective Herbicide Application* in square feet parallel to the ground surface divided by 43,560.

620.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Selective/Non-Selective Herbicide Application</i>	Acre

SECTION 621: MOBILIZATION

621.1 DESCRIPTION

This Work consists of mobilization, remobilization and demobilization to and from a Project.

621.2 MATERIALS

The Contractor shall provide personnel, Equipment, Materials, and operating supplies to the Project site.

621.3 CONSTRUCTION REQUIREMENTS

Mobilization and demobilization shall consist of obtaining all required insurance, bonds and permits; preparatory Work and operations necessary for the movement of personnel, Equipment, supplies, and Incidentals to and from the Project site; this item shall also include the establishment of offices, buildings, and other facilities necessary for the Project, before beginning Work on the Project. It does not include mobilization and demobilization for specific items of Work for which payment is provided elsewhere in the Contract.

621.4 METHOD OF MEASUREMENT

The Accepted quantities complete in place will be considered for compensation as directed by the Project Manager.

621.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Mobilization</i>	Lump Sum

621.5.1 Work Included in Payment

The Department will pay the Contractor partial payments using the following procedure:

1. When five percent (5%) or more of the Total Original Contract Amount less mobilization is earned, 25 percent of the amount Bid for mobilization will be paid.
2. When ten percent (10%) or more of the Total Original Contract Amount less mobilization is earned, up to 50 percent, less previous amounts paid, of the amount Bid for mobilization will be paid.
3. When 25 percent or more of the Total Original Contract Amount less mobilization is earned, up to 75 percent, less previous amounts paid, of the amount Bid for mobilization will be paid.
4. When 50 percent or more of the Total Original Contract Amount less mobilization is earned, up to 100 percent, less previous amounts paid, of the amount Bid for mobilization will be paid.

The total sum of all Mobilization payments shall not exceed the Original Contract Amount Bid for the item.

The Department will not make additional payments for demobilization and remobilization due to shutdowns, whole or partial suspensions of the Work or for other mobilization activities required for satisfactory completion of the Contract.

SECTION 622: FIELD LABORATORIES AND FIELD OFFICES

622.1 DESCRIPTION

This Work consists of providing and equipping field Laboratories, supplemental field Laboratories, and field offices.

622.2 FIELD LABORATORY CONSTRUCTION REQUIREMENTS

622.2.1 General

The Contractor shall provide anti-theft mechanisms for digital scales.

The Contractor shall install a security light on the exterior portion of the field Laboratory near each exterior door.

622.2.1.1 Sanitary Facilities

The Contractor shall provide and maintain one (1) chemical toilet in satisfactory condition for each field Laboratory. The Project Manager will approve the model and location of the chemical toilet.

622.2.1.2 Eye Wash Facilities

The Contractor shall equip each field Laboratory with one (1) eye wash unit in accordance with ANSI Z358.1. The Contractor shall provide a portable unit and place it in a readily accessible location. When filled and ready for use, the unit will not weigh more than 55 lb and will have a minimum capacity of five (5) gal. The Contractor shall treat the flushing fluid with an antibacterial additive and change it as needed.

622.2.1.3 Electrical Power Requirements

The Contractor shall provide at least 15 kW of electric power to Type I field Laboratories and at least 35 kW of electric power to Type II field Laboratories. The Contractor shall provide a minimum service amperage of 120 A for Type I field Laboratories and 300 A for Type II field Laboratories.

The Contractor shall provide enough electric power so that the voltage measured at the electric outlets in the field Laboratory is 100 V AC to 130 V AC, 60 Hz for the nominally rated 115 V AC outlets; and 200 V AC to 260 V AC, 60 Hz for the nominally rated 230 V AC, 60 Hz outlets. The Contractor shall install devices necessary to protect electronic Equipment from damage, due to power surges in the main power supply line.

The Contractor shall label the electrical receptacles with legible information regarding voltage output.

622.2.1.4 Water Supply Requirements

The Contractor shall provide the Laboratories with a pressurized potable water system and replenish as necessary. The Contractor shall use a fiberglass or stainless steel tank system equipped with an automatic shutoff valve.

The Contractor shall drain, flush, and refill the water system every two (2) weeks.

The Contractor shall provide a device to monitor the water level in the system. The

Contractor shall place the water system indoors and under the counter top and sufficiently insulate it to keep the water from freezing.

The Contractor shall use a water supply system with a separate outside water inlet and the necessary valves to connect to a pressurized municipal water supply.

The Contractor shall provide Type I Laboratories with a 200 gal capacity water supply.

The Contractor shall provide Type II Laboratories with a 250 gal capacity water supply.

The Contractor shall provide distilled or de-mineralized water, as necessary, for testing purposes.

622.2.1.5 HEATING, VENTILATION AND AIR CONDITIONING REQUIREMENTS

622.2.1.5.1 Type II Field Laboratory HVAC

The Contractor shall provide Type II Laboratories with a central heating and refrigerated air conditioning system, with vents on the ceiling, capable of maintaining a temperature of 75 °F during cold weather and below 80 °F during hot weather. The unit will not draw in air from the sample room.

622.2.1.5.2 Supplemental Hot-Mix Asphalt Field Laboratory

The Contractor shall provide HMA field Laboratory with a central heating and refrigerated air conditioning system, with vents on the ceiling, capable of maintaining a temperature of 75 °F during cold weather and below 80 °F during hot weather. The unit will not draw in air from the sample room.

622.2.1.6 Field Laboratory Placement and Maintenance Requirements

The Contractor shall place field Laboratories and supplemental field Laboratories as directed by the Project Manager. These Laboratories will remain the property of the Contractor.

The Contractor shall maintain field Laboratories and supplemental field Laboratories for the duration of the Project. The Contractor shall remove these Laboratories when the Project is complete, unless released earlier by the Project Manager.

The Contractor shall place the field Laboratories and supplemental field Laboratories on the Project in a ready-to-use condition at least one (1) week before Project field-testing is necessary.

The Contractor shall place the field Laboratories so that the distance between the bottom of the door and the ground is less than six (6) inches or provide an adequate ramp with a skid resistant surface. The Contractor shall anchor the field Laboratories in position to prevent them from overturning.

622.2.1.6.1 Supplemental Field Laboratories

The Contractor shall provide a supplemental field Laboratory in accordance with the Contract.

The Contractor shall provide a heavy-duty cabinet with sound insulation and bolts for mounting a Ro-Tap or Mary-Ann shaker.

The Contractor shall provide a rigid steel stand, 30 inch high, capable of supporting the cabinet and Ro-Tap or Mary-Ann shaker in a stationary position while the shaker is operating.

The Contractor shall mount the Ro-Tap or Mary-Ann shaker at the location shown in the supplemental field Laboratory details, unless otherwise specified by the Project Manager.

622.2.1.6.2 Supplemental Hot-Mix Asphalt Field Laboratories

The Contractor shall provide a supplemental HMA field Laboratory in accordance with the Contract.

The Contractor shall use Class A concrete for the concrete slab foundation of the supplemental HMA field Laboratories; ensure that it measures 14 feet × 14 feet × eight (8) inches. At the conclusion of the Project, the Contractor shall remove the building and foundation and restore the site to an Acceptable condition at no additional cost to the Department.

The Contractor shall supply and install an accurately calibrated gyratory compactor for the supplemental HMA field Laboratory. The Contractor shall use a gyratory compactor that is a mechanical asphalt-mixture compaction device comprised of the following:

1. Reaction frame;
2. Rotating base;
3. Motor;
4. Loading system;
5. Loading ram;
6. Pressure gauge;
7. Height measuring and recordation system; and
8. Mold and base plate.

The National SuperPave Regional Center must approve the device for compaction of HMA mixtures. The Contractor shall transport the device by picking it up from the bottom with a forklift, and move manually on roller casters.

The Contractor shall provide the following items with the gyratory compactor at no additional cost to the Department:

1. Three (3) six (6) inch molds;
2. Extruder for specimen removal from mold;
3. Printer;
4. Printer cable;
5. Height standard block;
6. Serial cable;
7. Two hundred and fifty (250) specimen paper disks; and
8. Operating service manual.

The Contractor shall provide a power supply that will work on 115 V AC. A list of approved models is available from the State Materials Bureau.

The gyratory compactor will remain the property of the Contractor at the conclusion of

construction.

The Contractor shall provide and install a binder ignition oven for the supplemental HMA field Laboratory. The Contractor shall provide a binder ignition oven in accordance with AASHTO T 308. The Contractor shall supply the necessary safety Equipment, including a heat reflective face shield, high temperature gloves with 14 inch sleeves, and aluminized rayon or other heat reflective coat or apron.

The binder ignition oven and safety Equipment shall remain the property of the Contractor at the conclusion of construction.

The Contractor shall supply the following:

1. A fine aggregate angularity test apparatus;
2. A flat and elongated particles test caliper;
3. An asphalt mix sample divider, complete with one (1) quick funnel insert;
4. Four (4) sample containers; and
5. One (1) Material-handling chute.

The Contractor shall supply and install a calibrated Vacuum Drying Device in accordance with AASHTO PP 75-13. Vacuum Drying Compacted Asphalt Specimens for the supplemental HMA field Laboratory.

This test Equipment shall remain the property of the Contractor at the conclusion of construction.

A list of approved models of the test Equipment is available from the State Materials Bureau.

This test Equipment shall remain the property of the Contractor at the conclusion of construction.

622.2.1.7 Field Laboratory Computer Facilities

If the Contract specifies Type II field Laboratories, the Contractor shall provide the Laboratory with a personal computer. The Contractor shall maintain this computer for the duration of the Project. The Project Manager will approve the model and location of the personal computer. The computer Equipment shall remain the property of the Contractor.

The Contractor shall provide computer hardware in accordance with the following requirements, or latest industry standard, or greater:

1. Microprocessor: Minimum Dual-core 3.0 GHz i-7 or Xeon, with vPro technology;
2. Memory: Minimum of 16 gigabytes | (2) 8 GB sticks;
3. Hard disk: Minimum of 250 gigabytes SATA; 7200 RPM;
4. Media drives: 16x DVD \pm R/ \pm RW Multi-burner;
5. Monitor: 24-inch color graphics monitor, DVI/DisplayPort;
6. Printer: letter-quality color laser printer, eight (8) pages per minute minimum;
7. Minimum 11-inch x 17-inch flatbed and/or ADF scanner w/600 optical dpi;
8. Operating System: Windows 7 64 bit (x64) Professional and Windows 10 64 bit (x64) Professional; and
9. Microsoft Office Professional 2010.

The Contractor shall provide a power-surge protection device and dust cover for the computer, printer, and keyboard.

622.2.1.8 Field Laboratory Internet Access

The Contractor shall provide Internet access as approved by the Project Manager.

622.2.1.9 Field Laboratory Utilities

The Contractor shall equip the field Laboratory with telephone modular jacks in each separate Work area.

622.3 Field Office Construction Requirements

622.3.1 General

If the Contract specifies a field office, the Contractor shall provide a field office complete, in place, and operational before beginning Work on the Project.

If the field office is a mobile trailer, the Contractor shall ensure that it is in accordance with the Manufactured Housing Improvement Act of 2000, and Housing and Urban Development Manufactured Housing Program.

If the field office is a permanent building, the Contractor shall ensure it is in accordance with the UBC™, the Uniform Plumbing Code™, the Uniform Mechanical Code™, and the NEC®.

The Contractor shall make sure the field office has convenient access to the Highway and is located within reasonable distance of the Project.

The Contractor shall locate the field office site where telephone and cellular service is available.

The Contractor shall make sure the field office is clean, with electrical outlets and other accessories and appliances in good working order.

The Contractor shall make repairs to the field office as necessary.

The Contractor shall make sure the field office has sufficient parking for at least 15 vehicles. The Contractor shall keep the parking areas free of mud, snow, and debris.

The Contractor shall enclose the field office and parking lot with a chain-link security fence at least six (6) ft high. The Contractor shall make sure the fence has an access opening at least 16 ft wide and one (1) or more chainlink gates at least six (6) ft in height at an appropriate location to allow vehicles to pass.

The Contractor shall provide the fence and gates with at least two (2) strands of barbed wire and security appurtenances at the top.

622.3.2 Field Office Architectural Requirements

The Contractor shall make sure the field office has at least 576 ft² of floor area.

The Contractor shall provide the field office with a minimum of 50 ft² of shelf space. The

Contractor shall equip the field office with:

1. At least one (1) closet with at least ten (10) ft² of floor space, and with a 24 inches wide door (with lock); and
2. At least one (1) closet with at least 15 ft² of floor space and 20 ft² of shelf space.

The Contractor shall provide the field office with at least two (2) office spaces separate from the rest of the field office by full partition and door. The Contractor shall ensure that these office spaces have at least 144 ft² of floor space each.

The Contractor shall ensure that the field office has sufficient overhead lighting so it requires no additional lighting.

The Contractor shall ensure that the field office has 18 gauge hollow core steel doors with 18 gauge steel casings on the exterior entrances.

The Contractor shall ensure that the field office has; 34 inch, nine (9) gauge, smooth expanded metal grating to cover the windows for security purposes. The Contractor shall weld the metal grating to an angle iron frame. The Contractor shall bolt the whole unit through the wall to an interior metal frame. The Contractor shall ensure that the grating opens or can easily be removed from the interior to comply with fire safety codes.

The Contractor shall cover the floors with suitable floor covering such as linoleum or carpeting. The Contractor shall ensure that blinds or curtains cover the windows and that the walls are finished.

622.3.2.1 Field Office HVAC Requirements

The Contractor shall equip the field office with an HVAC system that can maintain a temperature of at least 75 °F during cold weather and less than 80 °F during hot weather.

622.3.2.2 Field Office Equipment

The Contractor shall equip the field office with:

1. One (1) water cooler;
2. One (1) six (6) gal minimum capacity water heater;
3. A bathroom with lavatory and water closet;
4. One (1) drafting table;
5. One (1) worktable measuring approximately 30 inches x 96 inches; and
6. Two (2) chairs.

622.3.2.3 Field Office Utilities

The Contractor shall equip the field office with the following:

1. A potable water supply;
2. Adequate electrical power;
3. Other utilities required to operate the office; and
4. A system for wastewater disposal in accordance with State and local requirements.

The Contractor shall install devices necessary to protect electronic Equipment from power surges in the main power supply and communication lines.

The Contractor shall equip the field office with telephone modular jacks in each separate Work area, and provide an external telephone demarcation point.

The Contractor shall install a security light on the exterior portion of the field office near each exterior door.

622.3.2.4 Release of Field Office

The Department will retain possession of the field office for 90 Days after the final inspection or until released by the Project Manager, whichever occurs first.

622.4 METHOD OF MEASUREMENT—Reserved

622.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Field Laboratory Type II</i>	Each
<i>Supplemental Field Laboratory</i>	Each
<i>Supplemental Hot-Mix Asphalt Field Laboratory</i>	Each
<i>Field Office</i>	Each

622.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main item(s) and will not be measured or paid for separately:

1. Hookup and furnishing of utilities and appurtenances;
2. Security fencing;
3. Parking lot;
4. Basic Equipment as listed;
5. Foundations and anchoring;
6. All phone installations, internet access and monthly bills; and
7. Distilled or de-mineralized water for lab testing.

SECTION 623: DROP INLETS

623.1 DESCRIPTION

This Work consists of providing and installing drop inlets and junction boxes, and adjusting existing drop inlets.

623.2 MATERIALS

The Contractor shall provide Class A concrete in accordance with Section 510, "Portland Cement Concrete." The Contractor shall provide reinforcing steel in accordance with Section 540, "Steel Reinforcement." The Contractor shall provide Structural Steel in accordance with Section 541, "Steel Structures."

The Contractor shall provide coatings for Structural Steel in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

The Contractor shall provide preformed expansion joint filler in accordance with AASHTO M 213.

The Contractor shall provide precast units in accordance with Section 517, "Precast Concrete Structures."

623.3 CONSTRUCTION REQUIREMENTS

The Contractor shall construct drop inlets in accordance with Section 511, "Concrete Structures;" Section 540, "Steel Reinforcement;" and Section 541, "Steel Structures."

The Contractor shall precast the drop inlets and junction boxes or cast in place.

The Contractor shall raise the existing drop inlets by removing and reconstructing the top six (6) inches of the existing Structure. The Contractor shall reuse the existing grate, but provide a new frame.

623.3.1 Foundation Requirements

The Contractor shall compact the foundations of drop inlets and junction boxes to at least 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified), in accordance with Section 207, "Subgrade Preparation."

The Contractor shall replace unstable Material with structurally adequate Material before constructing new foundations.

623.3.2 Backfilling

The Contractor shall backfill in accordance with Section 206, "Excavation and Backfill for Culverts and Minor Structures."

623.3.3 Coating of Structural Steel

The Contractor shall coat Structural Steel for drop inlets in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

623.4 METHOD OF MEASUREMENT

The Department will measure reinforcing steel, concrete, and Structural Steel for drop inlet extensions in accordance with Section 540, "Steel Reinforcement," Section 511, "Concrete Structures," and Section 541, "Steel Structures," respectively.

623.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Median Drop Inlet, Type I, ___ to ___ ft</i>	Each
<i>Median Drop Inlet, Type ___</i>	Each
<i>Modified Median Drop Inlet, Type ___</i>	Each
<i>Curb Drop Inlet Type ___, ___ to ___ ft</i>	Each
<i>Curb Drop Inlet Type ___, over ___ ft</i>	Each
<i>Drop Inlet Type ___, ___ to ___ ft</i>	Each
<i>Drop Inlet Type ___, over ___ ft</i>	Each
<i>Transverse Drop Inlet Type ___, ___ to ___ ft</i>	Each
<i>Transverse Drop Inlet Type ___, over ___ ft</i>	Each
<i>Junction Box</i>	Each

623.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Subgrade preparation;
2. Compaction;
3. Replacement of unsuitable foundation Material;
4. Excavation and backfilling for drop inlets;
5. Coating of Structural Steel;
6. Reinforcing steel, concrete, and Structural Steel (Except on Extensions);
7. Removal of the top six (6) inches on extensions;
8. Gravel for drain pocket and hardware cloth for the weep holes; and
9. De-watering.

SECTION 624: WIRE MESH FOR SLOPE STABILIZATION

624.1 DESCRIPTION

This Work consists of Roadway slope stabilization to restrain and channel rockfall.

624.2 MATERIALS

624.2.1 Anchor Cable

The Contractor shall provide anchor cable with a diameter of at least 1/2 inch. It shall be zinc-coated steel wire strand, common grade, Type 1 coating, in accordance with ASTM A 475.

624.2.2 Resin-Grouted Steel Bolt Systems

The Contractor shall provide a resin-grouted steel bolt system with the best standard products of a manufacturer regularly engaged in the production of this type of installation and of the manufacturer's latest approved design.

The Contractor shall use resin-grouted steel bolts and hooked anchors with a minimum diameter of 3/4 inch. The Contractor shall use the headed type with flash forging. The Contractor shall use steel bolts with the following tensile properties:

1. Minimum yield strength: 43,000 psi; and
2. Minimum ultimate strength: 70,000 psi.

The Contractor shall use steel bolts and hooked anchors manufactured from any of the grades of deformed bars specified in ASTM A 615. The Contractor shall use steel bolts and hooked anchors specifically designed for resin grouting with lugs, vertical ribs, and deformations to provide thorough mixing of the resin and to center the steel bolts in the drilled holes.

624.2.2.1 Resin Cartridges

The Contractor shall provide the type of resin cartridges, as per the manufacturer's recommendations, designed for a 0.9 inch diameter cartridge in a one (1) inch diameter hole with a 3/4 inch bolt or anchor.

624.2.3 Earth Anchor Systems

The Contractor shall use earth anchor systems with the best standard products of a manufacturer regularly engaged in the production of this type of installation and of the manufacturer's latest approved design. The Contractor shall use earth anchor systems designed for the conditions encountered and as approved by the Project Manager.

624.2.4 Bearing Base Plates

The Contractor shall use bearing base plates that are six (6) inches square or six (6) inches diameter round plates in accordance with ASTM F 432.

624.2.5 Certification

The Contractor shall submit to the Project Manager for approval any manufacturer's certificates, literature, and shop drawings at least two (2) weeks before beginning the Work.

Shop drawings will, at a minimum, include spacing, bolt/anchor length, working load, and minimum required torque.

624.2.6 Slope Stabilization Wire and Wire Mesh

The Contractor shall provide tie wire and wire mesh in accordance with Section 602, "Slope and Erosion Protection Structures."

624.2.6.1 Polyvinyl Chloride Coated Wire Mesh

In addition to Section 602, "Slope and Erosion Protection Structures," the Contractor shall use PVC-coated wire mesh and connections in accordance with the following:

1. Extrude the PVC coating onto the wire core before weaving the coated wire;
2. Overall minimum diameter (galvanized wire core plus PVC coating) is 0.1338 inch;
3. Edging wire will be a galvanized wire core, with a diameter of at least 0.1338 inch (approximate U.S. gauge 10), coated with PVC, and having a minimum overall diameter of 0.1638 inch; and
4. Lacing wire will be a galvanized wire core, with a diameter of at least 0.0866 inch (approximate U.S. gauge 13.5), coated with PVC, and having a minimum overall diameter of 0.1166 inch.

624.2.6.2 PVC Coating

The Contractor shall provide protective PVC coating that resists the damaging effects of natural weather exposure or immersion in salt water and that does not show any Material difference in its initial compound properties in accordance with Table 624.2.6.2:1, "PVC Coating Physical Property Requirements."

**Table 624.2.6.2:1
PVC Coating Physical Property Requirements**

Property	Required value	Test method
Initial Property Requirements	—	—
Specific Gravity, kg/Dm ³	1.30–1.35	ASTM D 792
Durometer Hardness	50–60	ASTM D 2240
Shore D	—	ISO 868
Volatile Loss, Maximum	—	ASTM D 1203
@ 105 °C for 24 h	Two percent (2%)	ISO 176
@ 105 °C for 240 h	Six percent (6%)	ASTM D 2287
Tensile Strength, kg/cm ² , Minimum	210	ASTM D 412
Elongation, %	200–280	ASTM D 412
Modulus of Elasticity, kg/cm ² , Minimum	—	—
100% of Elongation	190	ASTM D 412
Resistance to Abrasion, gm, Maximum	0.19	ASTM D 1242 – 95a
Brittleness Temperature, °C, Maximum	–30	BS 2782-104A
Cold bend temperature	+15	BS 2782-150B

**Table 624.2.6.2:1
PVC Coating Physical Property Requirements**

Cold flex temperature	—	—
Creeping Corrosion, mm, Maximum ^a	25	—

^aPenetration of corrosion of the wire core from a square cut end when the specimen has been immersed for 2,000 h in a 50% solution of hydrochloric acid 12 Be.

624.3 CONSTRUCTION REQUIREMENTS

The Contractor shall prepare top and bottom of slopes by trenching.

The Contractor shall scale slope faces in accordance with Section 626, "Scaling of Rock Slopes," before installing steel bolts/anchors and draping and anchoring the wire mesh.

624.3.1 Anchor Hole Preparation

The Contractor shall drill bore holes for steel bolts/anchors approximately perpendicular to the rock face, except in areas approved by the Project Manager, incline the boreholes to a maximum of 30° off the perpendicular in order to intercept and seat the steel bolts/anchors in solid rock.

Upon completion of drilling, the Contractor shall blow the drilled holes clean with compressed air with an operating air pressure of at least 50 psi introduced at the back of the hole.

The Contractor shall use the manufacturer's recommended hole diameter for the steel bolts/anchors.

The Contractor shall ensure that the clearance between the steel bolt/anchor and borehole wall is from 1/8 inch to 3/16 inch.

624.3.2 Anchor Installation

The Contractor shall carefully follow the manufacturer's recommended installation procedures for steel bolts/anchors.

During construction, the Contractor may reduce the center-to-center spacing in order to maximize anchorage by selective bolting/anchoring in sound rock or to eliminate large voids between the wire mesh and the slope face.

The Contractor shall use steel bolts/hooks anchors that are at least six (6) feet long. The Contractor shall ensure that the steel bolts extend at least one (1) foot into sound rock.

As construction progresses, the rock conditions encountered may require the lengths of the steel bolts/hooks anchors to be greater than the minimum length, so the Project Manager may direct varied lengths. If using varied lengths, the Department will allow the Contractor to use steel couplings or other methods recommended by the manufacturer.

624.3.2.1 Tensioning and Testing of Steel Bolts and Earth Anchors

The Contractor shall tension steel bolts and earth anchors in accordance with the manufacturer's recommendations. The Contractor shall use a minimum torque of 200 lbf•ft, unless otherwise specified.

After installation, test a randomly selected set of ten percent (10%) of the bolts or anchors to confirm the specified working load. If more than one third of these fail, the Contractor shall test all bolts/anchors.

After replacing the failed bolts and anchors, the Contractor shall test another randomly selected set of ten percent (10%) of bolts and anchors, not including those previously tested and Accepted. The Contractor shall repeat the procedure until obtaining the satisfactory results.

The Contractor shall replace unacceptable bolts and anchors at no additional cost to the Department.

624.3.3 Installation of Wire Mesh

If the Contract specifies, the Contractor shall use PVC-coated wire mesh.

The Contractor shall lap the wire mesh at least six (6) inches and securely bind the perimeter edges of wire mesh so that the joints formed by tying the selvages have a minimum strength equal to that of the body of the mesh.

The Contractor shall space ties, connectors, locking clips, or hog rings used for fastening edges four (4) inches apart or less. The Contractor may lace perimeter edges with binding wire by tightly looping it through every mesh opening.

The Contractor shall extend wire mesh down the face of the slope and anchor it to the face of the slope by resin-grouted steel bolts or anchors, as required.

The Contractor shall hold wire mesh in place by the bearing base plates to stretch it to the maximum and contour it to the existing surface.

The Contractor shall anchor the wire mesh at the bottom to contain loose debris and allow periodic maintenance and debris removal.

624.3.3.1 Alternate Anchoring Method

If specified in the Contract, the Contractor shall anchor wire mesh using anchor cable and hooked resin-grouted steel or earth anchors.

624.3.4 Site Maintenance

The Contractor shall maintain the Project area and keep it clear of falling rock and debris during construction and at Project completion. The Contractor shall dispose of waste and debris at locations approved by the Project Manager.

624.4 METHOD OF MEASUREMENT—Reserved

624.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Slope Protection Wire Mesh</i>	Square Yard
<i>Slope Protection Wire Mesh PVC-Coated</i>	Square Yard
<i>Resin-Grouted Steel Bolts</i>	Linear Foot
<i>Resin-Grouted Steel Anchors</i>	Linear Foot

Earth Anchors
Anchor Cable

Linear Foot
Linear Foot

624.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Trenching at the top and bottom of the slope;
2. Hauling and disposal of rocks and debris; and
3. Ties, lacing wire, clips, hog rings, plates, and other appurtenances.

SECTION 626: SCALING OF ROCK SLOPES

626.1 DESCRIPTION

This Work consists of removing loose and potentially unstable rock on slopes as designated in the Contract. Scaling may be classified as either Light Scaling or Heavy Scaling as designated in Section 626.3.2, "Designation of Scaling Types."

626.1.1 Submittals

626.1.1.1 Work Experience

The Contractor shall provide written evidence to the Project Manager that demonstrates satisfactory completion of two (2) rock slope scaling Projects completed within two (2) years of the Bid date. Work crews shall be under the direction and oversight of a Scaling Supervisor who has at least 1,500 hours of high scaling experience and is trained and/or experienced in first aid and emergency rescue techniques. Scaling crews shall have cumulative experience totaling more than 1,000 hours on Projects of similar scope and complexity to the Bid Project. The submittal shall include the names and resumes of Scaling Crewmembers and Scaling Supervisors, and shall include the names and Contact information of references who can verify successful completion of evidentiary Projects.

626.1.1.2 Work Plan

The Contractor shall submit a detailed Work Plan for each non-contiguous rock scaling location to the Project Manager at least 30 days prior to the beginning of Work. The Work Plan must be Accepted and approved by the Project Manager before any scaling Work may begin. If scaling is part of a larger construction Project, the Work Plan shall be compatible with the overall traffic control Plan and sequence of operations for the larger Project.

The Work Plan shall include the following:

1. Specific location, length and range in elevation of slopes to be scaled;
2. Method or methods of scaling to be used and type of Equipment required;
3. A rope safety Plan with proposed rope access and methods of anchorage;
4. The number and size of rock scaling crews to be employed on the Project;
5. Sequence of operations and construction schedule;
6. Provisions to be made for protecting the Roadway and adjacent facilities, Structures or property, including a temporary rockfall protection Plan that includes provisions for protecting the Roadway during non-working hours against rockfall, rollouts, etc.;
7. A removal and disposal plan for Material generated from the scaling Work; and
8. A traffic control Plan and hours of operation.

626.1.1.3 Review and Approval

The Project Manager will evaluate the Work experience and proposed Work Plan. The Project Manager will notify the Contractor if additional information is required and changes are necessary within 14 Days after receiving the submittals. Administrative approvals are subject to field verification of performance.

626.2 MATERIALS—Reserved

626.3 CONSTRUCTION REQUIREMENTS

626.3.1 Preparations for Scaling of Rock Slopes

Scaling of rock slopes should commence only after all Work is completed for Controlled Blasting and Rock Excavation as covered in Section 203, "Excavation, Borrow and Embankment," to accomplish final slope geometries as scheduled in the Plans. Scaling within the limits of a final backslope established by Controlled Blasting is as covered in Section 203.5.2, "Work Included in Payment for Excavation, Backfill, and Embankments."

The Contractor shall begin scaling only after Roadway protection measures are in place and the approved traffic control Plans for specified Work windows are in place and as authorized by the Project Manager. Traffic shall be protected from potential rockfall for the duration of the scaling Project, to include rockfall that may occur outside of working hours. The Contractor shall be responsible for protecting the Roadway and all appurtenances from any damage that results from scaling operations and shall be responsible for repairing any such damage at no cost to the Department.

The Contractor shall complete tree felling prior to performing other scaling Work. Temporary storage of felled trees in ditches shall not be permitted.

The Contractor shall provide the working foreman in accordance with Section 626.1.1.1, "Work Experience" to oversee the crew of scalers during all scaling Work. The Contractor shall not perform scaling without the scaling foreman on-site.

No heavy Equipment other than those approved in the Work Plans shall be permitted on the slope. The Contractor shall begin scaling operations at the top of the slope and proceed downwards, removing loose rock as the Work progresses. After completing the first scaling pass, the Contractor shall remove any loose rock and debris that failed to fall completely to the toe of the scaled area and shall continue scaling operations until scaling has been completed to the satisfaction of the Project Manager.

626.3.2 Designation of Scaling Types

The extent of the scaling will be determined by the Project Manager and/or as specified in the Plans. Scaling of rock slopes is subdivided into Light Scaling or Heavy Scaling of Rock Slopes as designated below based on Equipment, method, and size of rock to be scaled from slope.

626.3.2.1 Light Scaling of Rock Slopes

Light Scaling of Rock Slopes is designated for removal of individual rocks less than one (1) cubic yard in volume from the slopes using hand tools, hand scaling bars or other hand tools adequate to perform the required Work.

626.3.2.2 Heavy Scaling of Rock Slopes

Heavy Scaling of Rock Slopes is designated for removal of individual rocks greater than one (1) cubic yard in volume from the slopes or for rock removal that requires use of heavy Equipment such as long-reach excavators, cranes or similar machinery; portable hydraulic wedges or hydraulic hammers; portable powered equipment such as air pillows, pneumatic hammers or wedges or portable drills; chemical cracking agents; or blasting with light explosives.

If chemical cracking agents are used, the Contractor shall provide a detailed Plan to the Project Manager, including type of cracking agent, MSDS sheets, manufacturer's technical

data, hole spacing, and loading sequence. If explosives are used, the Contractor shall meet the applicable requirements of Section 203, "Excavation, Borrow, and Embankment."

626.3.3 Execution of Scaling of Rock Slopes

Unless otherwise approved, traffic shall not be stopped by scaling operations for more than 20 minutes at a time. The Roadway shall be sufficiently cleared of rock and slope debris during that 20-minute period to allow safe passage through the Work zone after each traffic stoppage.

Damage to adjacent Roadway facilities and components, existing rockfall protection Structures and appurtenances, or adjacent local government or private facility or property is not permitted unless specifically approved in the Work Plan. The Contractor shall repair or replace any pavement, guard rail, signage, Structures, property or other components, public or private utilities, and any private property or facility damaged due to the scaling Work, at no expense to the Department. The Contractor shall provide adequate means to protect motorists and surrounding property from injury and/or damage during rock scaling and all other activities, and is solely responsible for injury to persons or damage to property that may result from this Work. The Contractor shall conform to all Local, State, and Federal regulations for site safety, earthwork, and scaling, and shall obtain any necessary permits and/or licenses.

Inspections may be conducted by the Project Manager at any time to evaluate scaling activities, check on the progress of Work or assess the stability of the slope or individual rock blocks or masses. Adequate notice of the intent to inspect must be given to the Scaling Supervisor to allow time for cessation of scaling activities while persons other than scaling crewmembers are on site. The Contractor shall provide 48 hours advance notice to the Project Manager before completion of the Work to allow for final inspection of the exposed face.

Removal of rock and slope debris shall conform to the approved Work Plans, unless approved in advance by the Project Manager. Any additional rock identified during inspections as potentially unstable shall be removed at the direction of the Project Manager. Any large rock masses or blocks dislodged by scaling operations that are not transportable shall be reduced in size by mechanical or other approved means, and the Roadway shall be cleared of all debris and the site secured before it is re-opened to traffic.

626.4 METHOD OF MEASUREMENT

Light Scaling of Rock Slopes will be measured by the square yard of slope. Heavy Scaling of Rock Slopes will be measured by the square yard of slope.

626.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Light Scaling of Rock Slopes</i>	Square Yard
<i>Heavy Scaling of Rock Slopes</i>	Square Yard

626.5.1 Work Included in Payment

The following Work items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Work Plan;

2. Protection of Roadway and nearby facilities, Structures or property;
3. Crushing, hauling and disposal of volume of removed rock and slope debris Material;
4. Placement and removal of temporary rockfall protection barriers; and
5. Repair and/or replacement of damaged facilities.

The Contractor shall dispose of Material in accordance with Section 107, "Legal Relations, Environmental Requirements, and Responsibility to the Public" unless otherwise specified in the Contract. The Contractor shall not dispose of Material within the Project limits without written approval from the Project Manager.

SECTION 630: GLARE SHIELDS

630.1 DESCRIPTION

This Work consists of providing and installing glare shields.

630.2 MATERIALS

The Contractor shall provide new Material for permanent installations or "like-new" Material for temporary installations.

The Contractor shall provide glare shields from the Department's *Approved Products List*.

The Contractor shall obtain Project Manager approval of "like-new" glare shielding systems for temporary installations before installation.

630.2.1 Mounting System

The Contractor shall use a mounting system with an approved steel mechanical anchor bolting system. The Contractor shall ensure that each anchor has a minimum 3,000 lb pullout and shear strength.

630.2.1.1 Multiple Glare Shield Blade Systems

For multiple glare shield blade systems, the Contractor shall flush mount and internally thread the anchors to allow for removal and replacement of the base rail without damage to the anchors.

The Contractor shall use a base rail made of a corrosion-resistant Material or protected with a rust-inhibiting coating.

630.2.2 Glare Shield Blades

The Contractor shall provide glare shield blades in accordance with the following requirements:

1. Use blades of a durable impact-resistant, non-warping, and nonmetallic Material;
2. The blade Material will not deviate more than 15% in the tensile strength and elongation values evident at 70 °F if tested at -20 °F and 120 °F in accordance with ASTM D 638;
3. The blade Material will not deviate more than 15% in the tensile strength and elongation values evident at 70 °F after 2,000 h exposure if tested in accordance with ASTM D 638 and ASTM G 154; and
4. The blade color shall be as approved by the Department.

630.3 CONSTRUCTION REQUIREMENTS

The Contractor shall place four (4) inch × 12 inch Type IX reflective sheeting, yellow or white as appropriate, on the blades at 40 ft intervals.

630.3.1 Glare Shield Blade Spacing

The Contractor shall space glare shield blades at intervals that will block the light within the glare zone, defined as the zone 22.5° left and right from the axis of headlight.

The Contractor shall make the spacing uniform and uninterrupted for the entire length of the installation.

630.3.2 Base Rail Construction Requirements

The Contractor shall ensure that base rails for multiple glare shield blade systems fit within the top edge of the concrete wall barrier, or form around the edge in a manner that fits tightly against the concrete wall barrier.

The Contractor shall ensure that each base rail is a continuous, single unit spanning the length of the concrete wall barrier unit.

The Contractor shall not span joints between concrete wall barrier sections with the base rail units of multiple glare shield blade systems.

The Contractor shall secure each ten (10) foot base-rail unit to the concrete wall barrier with at least three (3) anchor points, unless the Project Manager or the manufacturer requires more anchors.

630.3.2.1 Blade-to-Base Rail Mounting Requirements

The Contractor shall mount the glare shield blades to the base rail by a bracket assembly that allows the replacement of individual blades.

The Contractor shall ensure that the bracket assembly holds the blade rigidly in a fixed position and is adjustable, allowing the blades to be switched for traffic passing left-to-left or right-to-right.

630.3.3 Repair of Inadequate Glare Shielding

The Contractor shall replace anchors that show inadequate bonding with the concrete wall barrier. The Contractor shall replace incorrectly placed glare shield blades.

Incorrect placement of a glare shield blade includes the following:

1. The blades have an incorrect skew angle;
2. The blades are not vertically erect;
3. The blades have non-uniform spacing; or
4. The anchors are loose.

The Project Manager will determine which items need to be repaired or replaced. The Contractor shall perform the replacement or repair of inadequate glare shielding at no additional cost to the Department.

630.4 METHOD OF MEASUREMENT—RESERVED

630.5 BASIS OF PAYMENT

Glare shields used for temporary construction traffic control will remain the property of the Contractor upon completion of the Project.

Pay Item	Pay Unit
<i>Individual Glare Shield Blades 12in</i>	Each

Individual Glare Shield Blades 24in

Each

Multiple Glare Shielding 12in

Linear Foot

Multiple Glare Shielding 24in

Linear Foot

630.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for glare shields and will not be measured or paid for separately:

1. Base rails, hardware, and anchoring appurtenances;
2. Relocation of glare shielding within the Project;
3. Maintenance, repair and replacement; and
4. Reflective sheeting, Type IX.

SECTION 631: RUMBLE STRIPS

631.1 DESCRIPTION

This Work consists of furnishing all tools, Equipment, and labor necessary to install milled rumble strips at the locations specified on the Contract.

631.2 MATERIALS

631.2.1 Equipment

The Equipment used shall be capable of removing the existing HMA/WMA Material to the dimensions and tolerances specified in the Contract. The removals shall be accomplished in a manner that does not scar the surface of the adjacent pavement.

The Contractor shall obtain Project Manager approval of the milling device.

631.3 CONSTRUCTION REQUIREMENTS

631.3.1 General

The Contractor shall make clearly incised grooves for the rumble strips, in accordance with the Contract. The Contractor shall place rumble strips in accordance with the details shown on the Plans or as directed by the Project Manager.

The Contractor shall remove or obliterate the rumble strips placed at locations other than shown on the Plans and restore the pavement to the satisfaction of the Project Manager.

631.3.2 Placement

The Contractor shall allow the HMA/WMA Material to cure for a minimum of 48 hours after compaction, before starting rumble strip Work. The Contractor shall mill the rumble strips with one (1) pass of the milling device. Immediately upon completion of the rumble strip installation, the pavement and grooves will be cleaned of all milling debris and the Contractor shall dispose of the milled Material in a manner approved by the Project Manager. Prior to applying the final coat of permanent pavement markings, the Contractor shall seal all rumble strip surfaces, including vertical surfaces with an approved emulsified Material.

631.3.3 Alignment Control

The Contractor shall insure that a continuous control line is present as a guide for installation. The milling machine shall also be equipped with an approved guide that is clearly visible to the operator so that proper alignment of the rumble strips will be obtained.

631.4 METHOD OF MEASUREMENT

The Department will measure the rumble strips longitudinally, beginning at the transverse center of the first milled strip and proceeding along the centerline of the rumble strip pattern to the transverse center of the final milled strip in the pattern including breaks that are part of the rumble strip pattern. The Department will not include in the measurement breaks at exits, principal intersections, and or other interruptions indicated in the Contract.

631.5 BASIS OF PAYMENT

Pay Item	Pay Unit
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The Accepted quantities of milled rumble strips, measured as provided above, will be paid for at the Contract unit price per linear foot, which price shall be full compensation for the Work complete in place as shown on the Contract and as specified herein.

631.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Equipment and labor;
2. Repair of incorrectly placed rumble strips;
3. Continuous application of emulsified Material to completed rumble strips; and
4. Repair of damaged pavement.

SECTION 632: REVEGETATION

632.1 DESCRIPTION

This revegetation Work consists of preparing the soil, seeding, mulching, crimping, and the application of tackifier to areas stripped of vegetation during construction operations and are required to be revegetated. For additional information refer to the US Clean Water Act as outlined in the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP). Construction staking and digital submittals are included in the scope of the revegetation Work. The Department and Subcontractor shall each have at least one (1) Section 632, "REVEGETATION" TTCP-certified person on the Project at all times.

632.2 MATERIALS

The Contractor shall provide submittals as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding," for all Materials to the Project Manager at a minimum of ten (10) working Days before revegetation Work commences. Submittals shall conform to the Specifications and the revegetation Plan, and shall be on the Approved Products List. After submittals have been approved as per procedures identified in Section 632.3.3, "Pre-Seeding Conference;" the Contractor may substitute products on the Approved Products List with prior approval as per the same process. Rock Mulch Material submittal shall be required and meet the Specification but does not need to be on the Approved Product List. Submittal shall be a full five (5) gallon bucket sample provided to the Project Manager for sieve analysis.

All bulk Materials delivered to the Project shall be accompanied by a certified weigh master ticket for Materials utilized per Project as per Section 109.1, "Measurement of Quantity." Split loads of fertilizer, seed, straw, tackifier, and bonded fiber matrix may be allowed with proper weigh master ticket and Contractor affidavit. Split loads shall not be allowed for compost mulch and rock mulch.

All packaged Materials delivered to the Project shall be wrapped or otherwise securely protected from weather which might affect their integrity. Materials in weather-damaged packaging shall be rejected for use on the Project.

Certification for bulk Materials shall comply with Section 106.4, "Certificates of Compliance." Notify Project Inspectors when bulk Materials are delivered so loads may be inspected and verified.

The Contractor shall ensure that straw bales stored on the Project shall not exceed 20% moisture content.

632.2.1 Temporary Soil Stabilant/Tackifiers for Class A Seeding

Temporary soil stabilant and tackifier shall be considered the same and the terms used interchangeably. Tackifiers shall have a blue or green dye lasting a minimum of 36 hours to aid in application and inspection, and be bio-degradable. When used as part of seeding operations it shall be applied at a rate of 200 pounds per acre.

Tackifiers shall be plant-derived and bio-degradable and be composed of either guar, psyllium (*Plantago ovata*), or starch.

Guar. Guar is a plant based product derived from the ground endosperm of the guar plant, treated with dispersant agents for easy mixing.

Psyllium. Psyllium is composed of the finely ground muciloid coating of *Plantago ovata* seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but re-wettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires twelve (12) to eighteen (18) hours drying time.

Starch. Starch is non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. The Material is mixed with water. Approximate drying time is nine (9) to twelve (12) hours.

632.2.2 Seed for Class A and C Seeding

The Project seed list shall conform to the NMDOT Revegetation Zone and Seed List Maps at the NMDOT website or at the following link: <https://arcg.is/2peB6Cc>.

The list used shall be the year the Project was let. The Contract shall specify varieties of noxious weed-free seed in accordance with New Mexico Seed Law (NMSA 1978, § 76-10-11 et seq.).

Seed submittal shall be a list from a seed producer showing the common name, botanical name, pure live seed, total poundage, source locality (county and state), and NMDOT Project control number as per the revegetation/erosion control Plan.

All seed suppliers must be on the current Approved Products List and provide documentation that their regulating state agency belongs to the Association of Official Seed Certifying Agencies (AOSCA).

Seed mixtures shall be pre-mixed and bagged certifying the mixture quantity and percentage as noted in the Contract.

Substitutions for unavailable seeds shall be performed by adding the quantity of the unavailable seed to the quantity of the next seed species listed within that subcategory of the seed list. Before substitutions can be made the Contractor must provide proof of unavailability in letter form from three (3) seed suppliers listed on the NMDOT Approved Products List that the seed is not available.

All seed delivered to the Project shall be stored in a container protected from rodents and moisture and not subject to temperatures higher than 90°F.

632.2.2.1 Seed Labeling

The Contractor shall seal and label each bag in accordance with the Federal Seed Act (7 U.S.C. § 1551 et seq.) and NMDA seed labeling requirements (NMSA 1978, § 76-10-13). The Contractor shall provide the following information on each bag tag for each species:

1. Variety (specify if certified);
2. Kind of seed;
3. Lot number;
4. Purity;
5. Germination;
6. Percentage crop seed, percentage inert, percentage noxious weeds, in accordance with New Mexico Seed Law (NMSA 1978, § 76-10-11. et seq);
7. Origin;
8. Test date; and
9. Weight (in pounds) of this species or percentage of total lot.

The Contractor shall provide seed analysis results that are not older than twelve (12) months prior to use.

Seed suppliers shall provide one (1)-acre seed bags.

The Contractor shall provide to the Project Manager documentation of seed origin and pure live seed content from a certified testing Laboratory. Seed must arrive in the original sealed containers from the Supplier and the Revegetation Contractor must provide all tags and certifications to the Project Manager. Certification must be provided that the seed has been stored in appropriate conditions in the twelve (12) months before arriving at the Project. Each seed tag shall be affixed to the bag and have the project control number clearly identified. The certified seed Supplier shall maintain records of seed tag control numbers for a period of three (3) years.

632.2.3 Fertilizer for Class A and C Seeding

Fertilizer shall be organic, slow release with an N-P-K (nitrogen, phosphorous, potassium) analysis of either 3-6-3 or 3-7-2 and blended with endo-mycorrhizza and humates. Application rate shall be 1,000 lbs. per acre. Humates must comprise a minimum of 15% by weight. Endo-mycorrhiza must be arbuscular with a minimum propagule of 1.33 propagules per gram. The Contractor shall provide fertilizer (specified type and formulation) and supplier's certification in accordance with the Contract. Each bag or tote of fertilizer shall have a visible, sealed, and un-altered analysis tag from the manufacturer that must be approved by an authorized Section 632, "Revegetation" certified Inspector prior to application of the Material. The tag must include the manufacturer's information, the N-P-K analysis of the product, and the weight of the bag or tote. NMDOT reserves the right to inspect any bill of ladings or packing slips from the supplier to verify quantity of Material on site.

632.2.4 Hydro-Mulch - Bonded Fiber Matrix (BFM) for Class C Seeding

Hydro-mulch shall be Bonded Fiber Matrix (BFM). BFM is a hydraulically-applied blanket that controls soil erosion and accelerates seed germination. BFM is a three (3)-dimensional composite of wood or paper fibers bonded by polymer tackifier that provides high performance erosion prevention on slopes. Dye and tackifier shall be included in the BFM formulation. BFM shall be applied at a rate of 2,000 lbs per acre. As a hydraulic erosion control product (HECP) as defined by the Erosion Control Technology Council, the BFM or its equivalent shall be Type 3 or higher in functional longevity as defined in Table 1 of the 2014 Standard Specifications for Hydraulic Erosion Control Products (HECPs) Part 2.01.

632.2.5 Rock Mulch for Class C Seeding

Rock Mulch shall be between one (1) inch and no greater than 1 ½ inches in size. Rock shall have a minimum of two (2) Fractured Faces. Rock which is black in color will not be Acceptable. Pumice rock is not Acceptable.

632.2.6 Composted Mulch for Class A Seeding

The Contractor shall furnish and place composted mulch as shown on the revegetation Plan and in accordance with the criteria as described below. Composted mulch provider must be registered with or permitted by the New Mexico Environment Department Solid Waste Bureau and must be in compliance with 20 NMAC 9.1.

Composted mulch is defined as the product of a controlled aerobic thermophilic biological decomposition process that meets the quality requirements in Table 632.2.6:1, "Requirements

of Compost Mulch.” Raw Materials used in producing composted mulch may include green waste, animal manure, animal bedding, paper waste, food waste, biosolids or other non-toxic organic matter, but shall not include animal mortalities.

**Table 632.2.6:1
Requirements of Compost Mulch**

Material	Measure	Method	Criterion
All Composted Mulches	Moisture Content*	Evaporative loss at 105°C	Between 35 % and 60%
	Carbon/Nitrogen Ratio*	Nitrogen by AOAC 993.13, Carbon by ASTM D5373	Between 15:1 and 20:1
	Particle Size	Sieve	40% minimum to 100% maximum of Material may pass ¾ inch screen; 100% of pieces smaller than 4 inches in length and 2 inches in diameter
	Electrical Conductivity*	1:5 slurry (mass basis)	<10 mmho/cm
	pH*	1:5 slurry (mass basis)	pH 5.0 – pH 8.0
	Organic Matter*	Loss on ignition at 550°C	25% - 100% of dry weight
	Maturity	Germination test in 50:50 (volume basis) mixture of ¾ inch screened composted mulch and twice-rinsed nursery sand.	Minimum 50% germination to second set of leaves for marigold seeds
	Stability	By temperature and moisture content	Maximum core temperature of 110°F after 48 hours in 5 foot tall conical pile, with moisture adjusted to between 40% and 60%.
	Debris	By volume	Less than one percent (1%) inorganic debris, including but not limited to, glass, plastic, stones and metal.
Composted Mulches with Wastewater Biosolids	Trace Metals*	HNO ₃ digestion	Complies with Table 3 of 40CFR503.13
	Fecal Coliforms*	MPN with A-1 broth	<1000 MPN/dry gram
*Tests marked with asterisks must be performed by a suitable analytical Laboratory; other tests may be performed by the composted mulch producer.			

632.2.6.1 Acceptance

Compost mulch suppliers on the Approved Products List are approved for Project use.

The NMDOT Landscape Architect shall review lab analysis and submittals from the compost producers every 180 Days and confirm their listing on the Approved Products List.

Before delivering composted mulch, provider shall furnish documentation that includes the following:

1. The raw Materials, by percentage of volume, used in the production of the delivered composted mulch;
2. Daily temperature records for at least 20% of the piles or batches used to produce the delivered composted mulch, illustrating attainment of at least 130°F for at least seven (7) consecutive Days;
3. A Laboratory analysis for criteria shown in Table 632.2.6:1, "Requirements of Compost Mulch" performed on composted mulch no more than 180 Days prior to delivery; and
4. An affidavit, signed by a corporate officer, confirming that the composted mulch meets each requirement shown in Table 632.2.6:1, "Requirements of Compost Mulch."

632.2.6.2 Straw Mulch for Class A Seeding

The Contractor shall not use rotten or moldy straw. All straw mulch must be barley straw and is to be free of noxious weeds as certified by an industry-recognized forage certification authority. Certification twine must appear on all certified straw bales. The color of the certified twine for straw bales shall be listed on the certification submittal for identification purposes. The date on the straw certification provided to NMDOT may not be older than one (1) year from the date of purchase. Before Acceptance the Contractor shall provide to the Project Manager weigh tickets signed by a certified weighmaster as per Section 109.1, "Measurement of Quantity," which confirms that the amount of bulk Materials delivered to the Project equals tonnage required for the Project per the determined acreage.

632.3 CONSTRUCTION REQUIREMENTS

632.3.1 Equipment

All Equipment shall be inspected by the Contractor to confirm Equipment is in good working order prior to commencing Work. An Inspector shall witness the inspection and calibration.

To avoid the spread of noxious weeds, all revegetation Equipment (including but not limited to trucks, trailers, tractors, hydro-seeders, drill seeders, straw blasters, and disks) shall be pressure-washed to remove all visible mud, soil, and debris prior to entering the Project limits within the state right of way. If Equipment leaves the Project for any reason it shall be re-inspected when returned to the job site.

Disking attachments shall have a minimum six (6) foot carriage with front and rear discs.

Crimping Equipment shall have a minimum eight (8) foot wide carriage.

Skid steer attachments may only be used on confined areas for seeding operations.

Skid steers shall not be used for spreading compost unless in a confined area.

632.3.1.1 Drill Seeder

Drill seeding Equipment shall be inspected so that drill seed drop tubes are not torn or clogged. All seed loaded into Equipment shall be verified by an Inspector to confirm correct application rates. An Inspector must verify that the auger in the seed bin is rotating and that seed is dropping through drop tubes.

The drill seeder must be inspected daily to prevent loss of seed or to prevent over-seeding. Calibration is necessary to control rate and depth of seed distribution. Calibration procedure and demonstration shall be as per manufacturer's Specifications. The drill seeder shall be calibrated once per Project unless it is replaced on the Project. Drill seeders shall only be modified by manufacturer recommendation and documentation of the modification must be available.

The inspection shall ensure that the Equipment has the following:

1. Double disc openers with 'A' frames;
2. Depth bands;
3. Drop tubes;
4. Packer wheels or drag chains;
5. Rate control attachments;
6. Seed boxers with covers and agitators for trashy seed; and
7. Keyway holding auger to shaft.

632.3.1.2 Hydro-Seeder

The hydro-seeder cannons, hoses and agitators shall be in good working condition. The hydro-seeder shall be capable of applying Materials up to distances of 200 ft.

632.3.2 Materials and Sampling

Inspector must be present when Materials are to be loaded into Equipment or distributed on the areas to be seeded. Contractor shall provide all containers and bags to the Project Inspector for verification.

A one (1) quart sealed zip lock bag of seed Material labeled with the Material identification and the Project control number is to be provided to the NMDOT Landscape Architect for examination and testing. The Department may reject Materials not in accordance with the Contract.

632.3.3 Pre-Seeding Conference

A mandatory pre-seeding conference called by the Project Manager shall be held on the Project before revegetation Work begins. Attending will be the NMDOT Project Manager or representative, the NMDOT Landscape Architect or certified seeding Inspector, the General Contractor, and the Revegetation Contractor.

The purpose of the meeting is to inspect the Project, and off-site yards, pits, and borrow roads for confirmation of their revegetation requirements. The Project Manager shall have at the pre-seeding meeting documentation of all pits, Contractor yards, etc. approved for use on the Project. Per Section 632.3.12, "Seeding Operations for Class A and Class C Seeding," test strip location shall be verified following the Pre-seeding Conference. Construction staking must be completed and quantities must be verified by the Project Manager before test strip commences.

Submittals must be provided to the Project Manager and Landscape Architect ten (10) Days prior to the proposed start of revegetation Work. Any revegetation Work done prior to this inspection shall be rejected.

All areas to be revegetated shall be measured and confirmed for each class of seeding in accordance with Section 801, "Construction Staking by the Contractor." The Project Manager and the Contractor shall field verify and agree on the acreage for each Class of seeding, including Modified Class A, before any Materials are ordered or delivered to the Project.

Construction staking shall also identify all areas which have less than four (4) inches of soil cover and qualify for Modified Class A seeding.

The Prime Contractor shall provide minutes of this meeting for review and approval by the Project Manager and Landscape Architect or representative.

There will be no change in Materials or the scope of revegetation Work after the Contractor begins seeding operations.

For revegetation Work areas to be considered ready for revegetation they shall be accessible, free of Equipment, and no further construction processes occurring which would interfere with seeding operations. No further revegetation Work or Equipment access shall occur on areas which have been revegetated.

The Prime Contractor shall maintain a minimum twelve (12) foot wide Equipment access to all revegetated areas for use by revegetation Subcontractor until revegetation Work is complete.

632.3.3.1 Weather Limitations

Revegetation Work shall not be performed when the ground is frozen or when temperatures are below 32°F. No revegetation Work shall be performed when wind speed exceeds fifteen (15) miles per hour as measured with a wind meter by the Inspector.

632.3.4 Seeding Classes

The Contractor shall provide the various classes and the Material and operations for each class in accordance with Table 632.3.4:1, "Operations Sequence for Classes of Seeding."

**Table 632.3.4:1
Operations Sequence for Classes of Seeding**

Operation	Class		
	A	Mod A	C
Disk seed bed to four (4)"	X	X	--
Apply fertilizer by broadcast, then disk to four (4)"	X	X	--
Apply one (1) inch compost mulch, disk to four (4)"	X	X	--
Drill seed	X	X	--
Straw crimp; apply tackifier, dye	X	--	--
Track slopes with ridges horizontal and parallel to bottom of slope	X	--	X
Hand rake or chain harrow surface horizontally	--	--	X
Hydro apply seed, fertilizer, dye, tackifier	--	X	X

**Table 632.3.4:1
Operations Sequence for Classes of Seeding**

Operation	Class		
	A	Mod A	C
Scarify seeded areas horizontally to slope	--	X	X
Hydro mulch; apply tackifier, dye	--	--	X
Rock Mulch	--	X	X
Note: No seeding shall be applied on frozen ground Key: X = required; -- = not required			

632.3.5 Modified Class A Seeding for Narrow Areas or Areas Inaccessible to Drill Seeding Equipment

Any Project areas with slopes less than 3:1 requiring revegetation which are less than eight (8) ft wide, or are inaccessible to drill seeding Equipment, or are too rocky to disk to a four (4) inch depth, shall use the following procedure and payment is to be made at the Class A rate.

The Contractor shall disk soil to a four (4) inch depth with one (1) inch of incorporated compost mulch and fertilize as per Class A treatment. A skid steer with attachments may be used. If the seed bed is too rocky to disk to four (4) inches, the Contractor shall omit compost mulch and chain harrow or hand rake the entire area and proceed with Steps 1 and 2 below.

A hydro-seeder shall then be used to apply the seed, dye, tackifier, and hydro mulch in two (2) steps as described below.

Step 1. The Contractor shall apply seed and dye to the newly disked soil, rake or chain harrow so seed is covered with soil.

Step 2. The Contractor shall apply an approved bonded fiber mulch with tackifier applied in two (2) coats from opposing directions at rate of 2,000 lbs. per acre.

Seed in these areas shall be applied at twice the specified rates and no extra payment shall be made therefore.

632.3.6 Revegetation of Areas Outside the Project Limits

Revegetation of all disturbed off-site locations will be in accordance with Section 104.7, "Final Cleanup," and the appropriate class of seeding will be used for the terrain. Section 632, "Revegetation," procedures will be followed for all public lands and private lands that are required to be revegetated unless other seed lists and procedures are required in a resource agency permit. All revegetation Work done for permitted Contractor located activities shall be done at the Contractor's expense.

The Contractor must provide as part of submittals a letter of intent from landowners for off-site locations to be used as per Section 104.7, "Final Cleanup." The letter of intent must acknowledge the landowner's right to have revegetation performed as per our Specifications and if that revegetation right is waived the owner acknowledges that neither the Contractor nor NMDOT shall be responsible for any claims, including but not limited to fugitive dust, noxious weeds, and siltation of waterways, related to the owner's decision to forgo revegetation. When revegetation Work is being performed on private land, a right of access permit for

inspection of the revegetation Work for that private land must be provided by the Contractor to Project Management and shall be considered Incidental to the Work.

The Contractor shall provide documentation of the treatment used and notify Project Manager when the revegetation Work is being performed so Inspectors may be present.

**Table 632.3.6:1
Schedule of Materials for Class A Seeding**

CLASS A REVEGETATION MATERIALS PER ACRE				
TACKIFIER	COMPOST MULCH	SEED	STRAW	FERTILIZER
200 lbs	134 cubic yards	Per revegetation zone list	2 tons	1000 lbs.

**Table 632.3.6.2
Schedule of Materials for Class A Modified Seeding**

CLASS A MODIFIED REVEGETATION MATERIALS PER ACRE			
COMPOST MULCH	SEED	HYDRO MULCH WITH TACKIFIER	FERTILIZER
134 cubic yards	Per revegetation zone list X2	2,000 lbs	1000 lbs.

**Table 632.3.6:3
Schedule of Materials for Class C Seeding**

CLASS C REVEGETATION MATERIALS PER ACRE			
HYDRO MULCH WITH TACKIFIER	SEED	ROCK MULCH	FERTILIZER
2,000 lbs.	Per revegetation zone list X2	300 tons	1,000 lbs.

632.3.7 Materials Certifications

The Contractor shall provide all certifications for required Material to the Project Manager before the Project begins.

632.3.8 Seedbed Preparation for Class A Seeding

The Contractor shall till the seedbed with a disk, harrow, or chiseling tools to at least four (4) inches deep. Uproot competitive vegetation during seedbed preparation, and uniformly work the soil to a surface free of clods, large stones, or other Deleterious Material that would interfere with seeding Equipment. The Contractor shall ensure Inspector approves area that was disked before compost is added to the soil.

The Contractor shall add one (1) inch of compost mulch as specified by disc, harrow, or chisel to a depth of four (4) inches.

The same day as and preceding tilling compost mulch into the seedbed water shall be added to the compost mulch at a rate of 2,500 gallons per each 134 cubic yards. This is to aid

in the incorporation of the mulch into the seedbed. All compost mulch must be incorporated into the seedbed before adding fertilizer and commencing drill seeding. The Contractor shall add fertilizer by broadcast and disc, harrow, or chisel to a depth of four (4) inches.

The Contractor shall till across the slope, along the contour. The Contractor shall not till the seedbed if the moisture content of the soil is outside the limits recommended by the seed Supplier for planting, or the ground is in a non-tillable condition.

The Contractor shall not prepare more seedbed area on which the entire seeding operation can be applied before the surface crusts or loses seed and fertilizer to erosion. If erosion or crusting occurs, perform seedbed preparation again.

After seed bed preparation and before drill seeding commences all rocks larger than four (4) inches in diameter shall be removed from the seed bed and no payment shall be made therefore.

632.3.9 Tracking and Scarification for Class C Seeding

Areas designated as Class C treatment shall be track-walked as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding" with tracks parallel to the toe of slope to compact and score the slopes within seven (7) working Days prior to the commencement of Class C operations.

Slopes which have eroded or otherwise degraded in the seven (7) working Day period before seeding may need to be re-graded before revegetation.

Competitive vegetation shall be uprooted before hydro-seeding so that seed has good adherence to the surface and soil cover and no payment shall be made therefore.

Following tracking slopes shall be scarified by hand raking or chain harrowing horizontally and parallel to the bottom of the slope.

Following tracking of the slopes all rocks larger than four (4) inches in diameter shall be removed from the hydro-seed bed and no payment shall be made therefore.

632.3.10 Fertilizer for Class A and Class C Seeding

Fertilizer bags shall be examined before use to confirm correct analysis and content. Notify Project Inspector when bags are to be loaded into machines and all bags shall be collected and counted confirming correct amounts used.

The Contractor shall apply the fertilizer uniformly to the prepared seedbed. Class A shall be broadcast and Class C shall be hydro-applied. The Contractor shall apply mix fertilizer in the hydro-seeder for a minimum of ten (10) minutes before applying.

632.3.11 Compost Mulch for Class A Seeding

The Contractor shall wet down compost mulch so that wind loss is kept to a minimum. Stockpiles shall be less than six (6) ft tall and oriented perpendicularly to the prevailing winds to prevent wind loss.

The compost mulch moisture content shall be indicated on the delivery ticket at the time of delivery and shall be within the 35 – 60 % range.

Regardless of the compost mulch moisture content, the Project Manager may require

further wetting of compost mulch at delivery to prevent loss through wind. No extra payment shall be made therefore.

The certified Inspector shall verify the load is full before unloading to confirm the Material is up to the front of the trailer. Indications of a short load are gaps at the front of the truck, overloading at the back of the truck, and slip staining of the Material from the original loading line.

632.3.12 Seeding Operations for Class A and Class C Seeding

The Contractor shall uniformly apply the seed mix at a rate in accordance with the Contract. The Contractor shall not drive vehicles or other Equipment on seeded areas. The Contractor is responsible for protecting revegetation Work until Acceptance.

A test strip of each class of seeding shall be provided by Contractor before commencing general seeding. Each test strip shall measure no less than one (1) acre in a configuration which works for the Equipment and the site, shall be at a location of the Contractor's choosing within the Project, and shall be done as per Specifications with a certified Inspector and the Landscape Architect or representative present. Equipment calibration and a test strip are not required for Projects less than one (1) acre in size. The test strip is to verify Equipment functionality, proper adjustment, application rate, and the Contractor's ability to perform the Work as per Specification.

Upon Acceptance of the test plot the Contractor may proceed with seeding operations. If the test strip is not Accepted, the Contractor shall establish a new one (1) acre strip location and re-verify. The Contractor shall not proceed to full seeding operation until an Acceptable test strip has been produced. Payment will only be made for Accepted test strips and shall be made under appropriate class of seeding.

The Contractor shall coordinate with the Project Manager prior to starting seeding operations to ensure that an Inspector is present at all times. No revegetation Work shall be performed without the presence of a certified Inspector.

Once seed is installed on a given Project area all operations to complete that class of seeding for that area must be completed the same Day.

If rainfall or some other factor prevents the Contractor from seeding to the specified depth on prepared surfaces, the Contractor shall prepare the seedbed and apply seed again, at no additional cost to the Department.

Class C areas are to be seeded at twice the standard rate and no extra payment is to be made therefore.

The Contractor shall not perform seeding operations when wind velocity exceeds fifteen (15) mph. Disking may still be performed with winds exceeding 15 mph.

632.3.13 Drill Seeding for Class A Seeding

The Contractor shall plant seed 1/2 inch deep unless otherwise specified in the Contract. The Contractor shall ensure that the distance between the drilled furrows is no more than eight (8) inches. If the furrow openers on the drill exceed eight (8) inches, the Contractor shall re-drill the area and no extra payment shall be made therefore.

632.3.14 Hydro-Seeding for Class C Seeding

Seed shall be applied in a slurry with fertilizer and dye. All Materials loaded into Equipment shall be verified by NMDOT Project Inspectors to confirm correct application rates. The Contractor shall mix all Materials for a minimum of ten (10) minutes before application.

632.3.15 Hydro-Mulching for Class C Seeding

Hydro-mulching shall be applied in two (2) sweeps from opposing directions to ensure coverage is complete. The BFM must contain a tackifier when applied. A dye capable of lasting 36 hours shall be included in slurry so that Project Inspectors can confirm coverage. Mulch must be applied the same Day as the seed to protect seed. All Materials loaded into Equipment shall be verified by NMDOT Project Inspectors to confirm correct application rates. The Contractor shall mix all Materials for a minimum of ten (10) minutes before application.

The Contractor shall provide the Project Manager a laminated color reference card from the BFM manufacturer showing a close-up reference photograph of their product installed at the rate of 2,000 lbs. per acre.

632.3.16 Straw Mulching for Class A Seeding

The Contractor shall anchor straw mulch using a crimper with flat serrated discs at least one (1) inch thick with dull edges, spaced no more than nine (9) inches apart. The Contractor shall ensure that the disc diameter is large enough to prevent the frame of the Equipment from dragging in mulch.

The Contractor shall ensure that straw mulch crimping is at least two (2) inches deep and do not cover it with excessive amounts of soil. The Contractor shall perform mulch anchoring across the slope where practical, with no more than two (2) passes of the anchoring Equipment. Straw shall be evenly distributed over entire bedding area with no bare areas showing or areas with straw deeper than four (4) inches in depth before crimping.

The Contractor shall ensure that the rate of application of straw mulch is at least two (2) tons of air-dry straw per acre. The Inspector shall verify the total tons per acre of straw required per acre.

The Contractor shall ensure that straw mulch has at least 50% of fibers exceeding ten (10) inches long on the ground after application.

The Contractor shall spread straw mulch following drill seeding with a mechanical mulch spreader or by hand. If spreading by hand, the Contractor shall tear apart the bales of mulch and fluff it before spreading.

The Contractor shall anchor straw following crimping with an approved tackifier with green dye at a rate of 200 lbs. per acre. The tackifier shall be incidental to the seeding.

When crimping the straw is impractical due to rocky areas it may be spread and not crimped. Tackifier will be applied as per Specification. This method shall be approved by the Project Manager for rocky areas only.

When the revegetation Work is being done the Contractor shall verify straw bale moisture content with a straw bale moisture meter with an eight (8) inch minimum length probe for the duration of the Project. An Inspector must be present and record this test. The moisture meter shall remain the property of the Contractor following Project completion and the testing shall be considered incidental to the Project. Each bale must be tested to confirm that the bale interior moisture content is no greater than 20%. Any bales with moisture above this level shall be rejected and removed from the Project. Higher levels of moisture may indicate the

presence of mold and the risk of spontaneous combustion.

632.3.17 Rock Mulch

The finished rock mulch surface must be smooth and uniform maintaining the original flow lines, slope gradients, and contours of the job. Rock mulch must be applied in a fashion not to tear up or damage the hydro-mulch when being placed. Methods and means of rock mulch installation are not specified and may vary as per access. Damaged hydro-mulch shall be replaced and no extra payment made therefore.

632.3.18 Class C Slopes with over 50' of Slope Length

Class C slopes in excess of 50' of slope length (measured along the slope face from toe to crest) shall have the following treatment.

Class G rip-rap shall be used for the lower portion of the slope from the toe upwards to the point where there will not be more than 50' of slope length covered with 3/4 inch to one (1) inch rock mulch described in 632.2.5, "Rock Mulch for Class C Seeding," and Table 632.3.4:1, "Operations Sequence for Classes of Seeding." The rip rap shall be placed over the hydro-seeded and mulched surface in a way that does not damage the applied mulch treatment, shall be installed from the toe of the slope upwards and shall be one (1) layer of Class G rip-rap in thickness.

632.4 METHOD OF MEASUREMENT

The Contractor shall digitally provide for approval of a to-scale printable revegetation Plan as part of the submittals before the mandatory pre-seeding meeting. The Plan shall identify each area by station, numerical order, Project left, Project right, and is to indicate the class of seeding as per Table 632.3.4:1, "Operations Sequence for Classes of Seeding." Quantities shall match those produced by construction staking and shall include all off-site areas.

The Contractor shall identify on the Plan all areas identified by Construction Staking which have less than four (4) inches of soil cover and qualify for Modified Class A treatment as per Section 632.3.5, "Modified Class A Seeding for Narrow Areas or Areas Inaccessible to Drill Seeding Equipment."

An accompanying table to the Plan shall be submitted showing the amount of each Material apportioned for each area on the Project and the acreage of that sub-area. Included in the Plan shall be all off-Project areas requiring revegetation as enumerated in Section 632.5, "Basis of Payment."

632.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Class A Seeding</i>	Acre
<i>Class C Seeding</i>	Acre

632.5.1 Revegetation Work Included in Payment

The following revegetation Work items shall be considered as included in payment for the main items and shall not be measured or paid for separately:

1. Tackifier for straw mulch;

2. All compost mulch, fertilizer Materials, and water added at tilling;
3. Rock for rock mulch;
4. Moisture probe for straw bales;
5. Weed removal and disposal prior to seed operations;
6. Revegetation Plan;
7. Right of access permit to be provided by Contractor for inspection of off-site locations located on private property;
8. Multiple mobilizations to meet NPDES requirements; and
9. Construction staking.

SECTION 660: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

660.1 DESCRIPTION

This Work consists of performing excavation, trenching, and backfilling for underground utility lines.

660.2 MATERIALS—RESERVED

660.3 CONSTRUCTION REQUIREMENTS

660.3.1 Trenching and Excavation

Grades for underground utility lines are the invert (inside bottom of the pipe) unless the Contract specifies otherwise.

During excavation, the Contractor shall pile Material suitable for backfill in an orderly manner far enough away from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

The Contractor shall perform grading necessary to prevent surface water from flowing into trenches or other excavations; the Contractor shall remove water that has accumulated by pumping or with other approved methods.

The Contractor shall perform trenching far enough in advance of pipe laying to allow the Project Manager to make necessary grade changes. Unless otherwise specified in the Contract, the Contractor shall begin backfilling immediately after laying pipe and keep pace with pipe-laying operations.

660.3.1.1 Trench Widths

The Contractor shall ensure that trenches are wide enough to properly lay, align, grade, and joint the pipe. The Contractor shall dig trenches to at least 24 inches wide, but in no case should they exceed 1.4 times the outside diameter of the pipe, plus 24 inches, plus twice the thickness of shoring Structures, at the level of the top of the pipe.

The Contractor may use excavation for concrete Structures as the outside form, if approved by the Project Manager.

If trenching is behind a curb, in lawns, or adjacent to Sidewalks or walls, the Contractor shall ensure that the trench is not wider than the outside diameter of the pipe plus 24 inches at the trench top. The Contractor shall provide sheeting or bracing as necessary.

The Department will consider over depth excavation not ordered by the Project Manager as unauthorized. The Contractor shall fill the unauthorized excavation with granular or compacted embedment Material or concrete, as directed by the Project Manager at no additional cost to the Department.

660.3.1.2 Shaping Trench Bottoms

The Contractor shall accurately grade trench bottoms for pipe six (6) inches or smaller to provide uniform bearing and support throughout the length of each section of pipe. The Contractor shall finish the bottom of the trench by excavating a shallow concave groove at the line of the pipe and shape it approximately to fit the pipe.

The Contractor shall excavate trench bottoms for larger pipe to below the grade line, as necessary, to allow the installation of granular embedment foundation Material for the pipe.

The Contractor shall dig bell holes and depressions for joints after grading the trench bottom so that the full length of the pipe rests on the prepared bottom. The Contractor shall make these depressions the length, depth, and width necessary to properly fit the particular type of joint.

The Contractor shall not excavate below the specified final trench bottom elevation, unless the Contract requires granular embedment foundation Material.

660.3.1.3 Foundations

The Contractor shall remove wet or otherwise unstable soil, incapable of properly supporting the pipe, and backfill the trench to grade with granular embedment foundation Material or other suitable Material.

If the Contractor excavates deeper than the specified grade, the Contractor shall backfill the trench to grade with granular embedment foundation Material or other approved Material. The Contractor shall thoroughly tamp the replacement foundation Material to provide a solid bed for the pipe. The Project Manager will determine if Material from the trench is Acceptable.

660.3.1.4 Rock Excavation

The Contractor shall remove rock that is not rippable with a rip tooth, or that occurs in masses larger than 1/2 yd³ or ledges at least four (4) inches thick in accordance with Section 203, "Excavation, Borrow, and Embankment."

If the Contractor encounters solid rock during excavation, the Contractor shall excavate to a depth six (6) inches below the outside bottom of the pipe and backfill the trench to the proper grade.

If Materials cannot be handled or compacted as earth (including rock), the Contractor shall separate them from excavated Materials that the Contractor shall use as fill or Embankment Material.

The Contractor shall dispose of rock separated from fill Material as approved by the Project Manager.

660.3.1.5 Wet Excavation Requirements

The Contractor shall keep trenches and other excavations free of water by bailing, pumping, or draining during construction operations. The Contractor shall keep water away from concrete or cement joints until the Materials attain initial set.

The Contractor shall provide the following, as necessary:

1. Cofferdams;
2. Pumps;
3. Drains;
4. Ditches;
5. Well points; and
6. Other means for removing water from the excavations or other parts of the Work and for preventing excavated slopes from sliding or caving.

The Contractor shall dewater for at least 24 h in the vicinity of concrete to allow the concrete to set properly. The Contractor shall dispose of water by pumping it into ditches, storm drains, or sanitary sewers in accordance with applicable regulations.

660.3.2 Bracing and Sheeting

The Department will allow the Contractor to cut trench banks on slopes to prevent sliding and caving where the increased trench width will not interfere with surface features or encroach on Right of Way limits. Slopes may not intersect vertical trench walls more than 12 inches above the top of pipe.

The Contractor shall not remove sheeting and bracing until sufficient backfill is in place to protect the utility Structures and the adjacent Roadway from caving damage.

The Contractor shall leave sheeting in place if necessary and approved in writing by the Project Manager. The Contractor shall cut off sheeting left in place at least one (1) ft below the ground surface.

660.3.3 Bedding and Backfill

The Contractor shall provide bedding and backfill for utilities in accordance with Section 663.1.1, "NMSSPWC Appurtenant Stipulations," except, the Contractor shall provide compaction within four (4) ft of pipe and utility appurtenances, under the Roadway Prism, to 95% of maximum dry density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

If backfilling uncased pipe, the Contractor shall not break, chip, crush, crack, or otherwise damage the pipe. The Contractor shall backfill polyvinyl chloride pipe only if the pipe is 75 °F or below.

660.3.3.1 Backfill Material

The Contractor shall provide backfill Material that, after placement and compaction, is capable of supporting the design loads. The Contractor shall provide backfill Material that is free of lumps, debris, other Deleterious Materials, and sharp rocks, stones, or other objects that might damage the pipe.

660.3.3.2 Backfill Compaction Operations

The Contractor shall compact backfill Material placed around irregular areas with hand-operated tamping Equipment. The Contractor shall compact anchor loads for pipe testing and other backfill placed before the regular trench backfill.

660.3.4 Contractor's Responsibility for Protection of Public Utilities

The Contractor shall repair damage to Structures, pipelines, conduits, cables, sewers, storm drains, or other utilities encountered in or adjacent to the excavation, due to the Contractor's negligence. The Contractor shall use reasonable measures and precautions, including Blue Stake or One Call, to protect utilities.

The Contractor shall locate underground utilities before excavating and provide support to protect these utilities and avoid damage or interruption in functions.

At least seven (7) Days before beginning excavation; the Contractor shall provide written

notification to owners of public utilities that may be affected by construction, so that the owners may make necessary arrangements.

The Contractor shall restore or rebuild property damaged by construction operations to at least the condition that existed before the construction operations.

The Contractor shall get the Project Manager's approval to relocate trench lines to avoid known obstacles. The Contractor shall permanently plug the dead ends left in the trench from removed abandoned pipes, conduits, or sewers.

660.3.4.1 House Service Connections

The Contractor shall not disturb or damage existing house lateral connections to utility mains. The Contractor shall replace broken lateral connections with the same type pipe or better, at no additional cost to the Department.

660.4 METHOD OF MEASUREMENT—RESERVED

660.5 BASIS OF PAYMENT

The Department will pay for authorized rock excavation in accordance with Section 203, "Excavation, Borrow, and Embankment."

The Department will pay for sheeting left in place at the direction of the Project Manager at an agreed price that does not exceed the actual Material cost.

SECTION 662: MANHOLES

662.1 DESCRIPTION

This Work consists of constructing manholes. The Contractor shall construct manholes complete with covers, steps, fittings, and other appurtenances. This Work also includes installation of reducing cones, manhole extensions, ties to existing manholes, manhole adjustments, and manhole frame and covers.

662.1.1 NMSSPWC Appurtenant Stipulations

The Contractor shall adhere to the applicable requirements of the *NMSSPWC*, except for the procedures for Method of Measurement and Basis of Payment.

662.1.1.1 Terms

The Contractor shall substitute "Engineer," as it appears in the applicable sections of the *NMSSPWC*, with "Project Manager." The term "Owner" refers to the entity owning the affected utilities on this Project.

662.1.2 Manhole Types

The Contractor shall use precast concrete sections to construct "Drop" and "Standard" manholes.

The Department defines "Drop" manholes as manholes that have outside pipe and fittings for dropping sewage into the lower line.

The Department defines "Standard" manholes as inside drop manholes, where the incoming line discharges directly into the manhole and does not require special fittings.

662.2 MATERIALS

662.2.1 General

The Contractor shall use new Materials of the best standard quality available for the intended purpose.

The Contractor may substitute Contract specified brand name Materials with generic Materials of equal quality if the Contractor provides adequate technical and descriptive data and the Project Manager approves.

662.2.1.1 Referenced Materials

The Contractor shall provide Materials in accordance with these *Standard Specifications* and the following sections of the *NMSSPWC*:

1. Section 106, "Cement Mortar and Grout;"
2. Section 108, "Brick;"
3. Section 123, "Reinforced Concrete Pipe;"
4. Section 124, "Reinforced Concrete Pressure Pipe;"
5. Section 128, "Concrete Cylinder Pipe;"
6. Section 130, "Gray Iron and Ductile Iron Fittings;"

7. Section 143, "Galvanizing;"
8. Section 160, "Steel Castings;"
9. Section 161, "Gray Iron Castings;" and
10. Section 162, "Aluminum Castings."

If the above-referenced Specifications and these *Standard Specifications* conflict, the Contractor shall use the more stringent.

662.2.1.2 Certification

Before installing an item or type of Material, the Contractor shall provide the Project Manager with a certification that the item or type of Material meets these *Standard Specifications* or the referenced Specifications.

662.2.2 Masonry

662.2.2.1 Concrete

The Contractor shall provide Materials for concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs."

662.2.2.2 Non-Shrink Mortar

The Contractor shall provide non-shrink mortar in accordance with Section 521, "Non-Shrink Mortar."

662.2.3 Fine Aggregate

The Contractor shall provide fine aggregate that passes a No. 8 sieve, but no more than four percent (4%) passes the No. 200 sieve.

662.2.4 Precast Sections

The Contractor shall provide circular precast concrete in accordance with ASTM C 478, except that the minimum thickness and the reinforcement will be in accordance with the Contract.

The Contractor shall provide circular or horseshoe-shaped box out openings for each connecting pipe, with the surfaces grooved or roughened to improve mortar bond.

662.2.5 Gaskets

The Contractor shall provide rubber or mastic gasket Materials in accordance with the following:

1. Mastic in accordance with Federal Specification SS-S-210; and
2. Rubber that is Neoprene, or another synthetic, and $40 \pm$ five (5) hardness if, measured in accordance with ASTM D 2240 and Type A durometer.

662.2.6 Coal Tar Paint

The Contractor shall provide one (1) of the following types of coal tar paint:

1. Koppers Bitumastic Super-Service Black;

2. Porter Tarmastic 103;
3. Tnemec 450 heavy Tenemecol, or;
4. An approved equal.

662.2.7 Castings

The Contractor shall provide castings in accordance with ASTM A 48, with asphalt varnish coating applied at the foundry.

The Contractor shall provide the following manhole rings and covers:

1. Neenah R-1736;
2. Clay and Bailey No. 2008;
3. McKinley ET 24 M; or
4. An approved equal.

The Contractor shall provide aluminum manhole steps or polypropylene-encased deformed-steel reinforcing bar manhole steps in accordance with ASTM C 478.

662.3 CONSTRUCTION REQUIREMENTS

662.3.1 General

The Contractor shall make excavations, as necessary, to determine the exact location of existing utilities that affect the new construction.

The Contractor shall repair damage to existing utilities at no additional cost to the Department.

The Project Manager will establish the final locations for new fittings, connections, etc. in the field. The Project Manager must approve modifications to the Contract before beginning the Work.

The Contractor shall submit a proposed sequence of construction to the Project Manager for approval before beginning the Work.

662.3.1.1 Waste Containment and Disposal Requirements

The Contractor shall dispose of Materials taken from sanitary sewers during cleaning operations at no additional cost to the Department.

The Contractor shall retrieve and dispose of sand and other debris from the sewers and secure a legal disposal site at no additional cost to the Department.

The Contractor shall not discharge removed sewage or solids onto Streets, ditches, catch basins, or storm drains.

662.3.2 Delivery

The Contractor shall not deliver precast concrete sections to the Project until representative concrete control cylinders have attained at least 80% of the specified minimum compressive strength. The Contractor shall inspect precast concrete sections upon delivery and the Contractor shall not use cracked, broken, or visibly defective units.

662.3.3 Placement Requirements

The Contractor shall use mortar within 40 min after mixing. The Contractor shall discard mortar that has begun to take on initial set and the Contractor shall not mix it with additional cement or new mortar. If necessary, the Contractor shall extend the manhole as directed by the Project Manager.

662.3.3.1 Inverts

The Contractor shall ensure that the dimension of the invert section through a manhole is greater than that of the outgoing pipe. The Contractor shall ensure that the shape of the invert conforms exactly to the lower half of the pipe it connects. The Contractor shall connect side branches with as large a radius of curve as practical. The Contractor shall trowel inverts to a smooth, clean surface.

662.3.3.2 Precast Sections

The Contractor shall provide circular precast sections with a rubber or mastic gasket to seal joints between sections. The Contractor shall fill the space between connecting pipes and the wall of precast sections completely with non-shrinking mortar.

662.3.4 Connections

The Contractor shall make connections in a sequence and method that minimizes inconvenience to the Owner. The Contractor shall obtain Project Manager approval of the sequence and method before making the connections.

To stop the flow of water to make the connection to the existing line, the Contractor shall only close existing valves in the presence of an Owner representative.

662.3.5 Manhole Frames and Covers

The Contractor shall cast or finish manhole frames and covers in accordance with the Plans.

The Contractor shall use machined cover seats and frame seats made of tough gray iron, free of cold chutes or blow holes, and with a finish to industry standards. The Contractor shall produce an indentation on a rectangular edge using a hammer without flaking the metal.

The Contractor shall perform the following to castings at the foundry:

1. Hammer inspection;
2. Thoroughly clean;
3. Dip in asphalt or coal tar; and
4. Oil at a temperature of from 290 °F to 310 °F.

The Contractor shall use manhole frames and covers in accordance with the Contract. The Contractor shall cast, finish, and machine the frame and cover so that the cover sits true and even, without rocking within the frame.

The Contractor shall ensure the position and spacing of the manhole step rungs are in accordance with the Contract.

662.3.6 Submittals

Two (2) weeks before installation, the Contractor shall submit drawings and data regarding precast concrete sections to the Department. The Contractor shall submit data and drawings regarding cast-in-place manholes to the Department in accordance with Section 510, "Portland Cement Concrete," and Section 511, "Concrete Structures."

662.3.7 Manhole Adjustments

The Contractor shall adjust manhole rings in existing paved Roadway using the following procedure:

1. Remove the existing ring and cover;
2. Place a 5/8 inch thick (minimum) steel plate cover on the manhole opening;
3. Salvage the existing manhole rings and manhole covers and return them to the Owner as directed;
4. Place and compact the required surfacing;
5. Locate the steel-plate manhole cover with a metal detector or other method approved by the Project Manager;
6. Cut a five (5) foot x five (5) foot square opening in the surfacing and remove the surrounding Material in accordance with the Plans (the control point of the square opening is the center of the manhole);
7. Install a manhole ring and adjust in accordance with the Plans;
8. Place the steel reinforcement and concrete (the Project Manager will determine the curing time allowed for the placed concrete before other Work adjacent to or over the concrete can be started); and
9. Place and compact the required surfacing.

The Contractor may propose an alternate method of adjusting manholes by providing the Project Manager the proposed procedure in writing. The Contractor shall not use the proposed procedure until Project Manager approval.

662.3.8 Miscellaneous Manhole Construction

If specified, the Contractor shall install reducing cones, manhole extensions, ties to existing manholes, manhole adjustments, and manhole frame and covers in accordance with the NMSSPWC.

662.4 METHOD OF MEASUREMENT

The Department will measure additional depth for adjusted manholes from the inside bottom of the manhole to the adjusted finished top of the manhole ring and compare that measurement to the Plan depth.

662.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Manhole Type __, __ft diameter __ft to __ft Depth</i>	Each
<i>Manhole Type __, __ft diameter over __ft to ____ft Depth</i>	Each
<i>Manhole Type ____</i>	Each
<i>Special Manhole Type ____</i>	Each
<i>Manhole, __ft diameter</i>	Each

<i>Sewer Manhole, ___inch diameter</i>	Each
<i>Drop Manhole, ___inch diameter</i>	Each
<i>___ inch x ___inch Reducing Cone</i>	Each
<i>Manhole Adjustment</i>	Each
<i>Manhole Extension</i>	Each
<i>Tie to Existing Manhole</i>	Each
<i>Manhole Frame and Cover</i>	Each

SECTION 663: UTILITY ITEMS

663.1 DESCRIPTION

This Work consists of trench excavation and backfill, and providing, installing, and connecting the specified utility items to existing utilities.

663.1.1 New Mexico Standard Specifications for Public Works Construction (NMSSPWC) Appurtenant Stipulations

The Contractor shall adhere to the applicable requirements of the *NMSSPWC* as referenced, added to, or modified for utility relocation and construction.

663.1.1.1 Terms

For the purposes of this section, substitute "Engineer," as it appears in the applicable sections of the *NMSSPWC*, with "Project Manager." The term "Owner" refers to the entity owning the affected utilities on this Project.

663.1.1.2 Applicable Sections

The following sections of the *NMSSPWC* shall apply, except as modified:

1. Section 700, "Trenching and Boring for Utilities;"
2. Section 701, "Trenching, Excavation, and Backfill;"
3. Section 710, "Boring, Drilling, and Jacking;"
4. Section 800, "Water Transmission Collector and Distribution Lines;"
5. Section 801, "Installation of Water Transmission, Collector and Distribution Lines;"
6. Section 802, "Installation of Water Service Lines;"
7. Section 900, "Sanitary and Storm Sewer Facilities;"
8. Section 901, "Sanitary Sewer Collector and Interceptor Facilities;"
9. Section 905, "Sanitary Service Lines;"
10. Section 910, "Storm Sewer Pipe Installations;"
11. Section 915, "Storm Sewer Drainage Appurtenances;" and
12. Section 920, "Sanitary and Storm Sewer Manholes."

663.1.1.3 Modifications to NMSSPWC

The sections listed above do not include references to measurement and payment; measurement and payment will be in accordance with Section 663.4, "Method of Measurement," and Section 663.5, "Basis of Payment."

663.1.2 Electrical

The Contractor shall perform Work in accordance with State and local codes and ordinances, the current edition of the NEC®, the rules and regulations of the local electrical company authority, and other authorities with jurisdiction. Whether shown on the Plans or not, the Contractor shall make modifications required by any of the above authorities at no additional cost to the Owner or the Department.

663.2 MATERIALS

The Contractor shall provide the following Materials in accordance with the Contract:

1. Pumps;
2. Pipes;
3. Tubing;
4. Fittings;
5. Manual valves;
6. Reduced pressure backflow preventers;
7. Instrumentation; and
8. Miscellaneous system components.

The Contractor shall provide new, unused Materials of the best quality available for the purposes intended. If the Contract specifies Materials by brand names, the Contractor shall substitute other brands of equal quality with Project Manager approval of a submittal detailing adequate technical and descriptive data.

The Contractor shall provide Materials in accordance with these *Standard Specifications* and the following sections of the *NMSSPWC*:

1. Section 100, "Materials;"
2. Section 101, "Portland Cement Concrete;"
3. Section 102, "Steel Reinforcement;"
4. Section 103, "Epoxy-Coated Steel Reinforcement;"
5. Section 105, "Concrete Curing Compound;"
6. Section 106, "Cement Mortar and Grout;"
7. Section 107, "Joint Filler and Sealant Material;"
8. Section 108, "Brick;"
9. Section 121, "Plastic Pipe (Water and Sanitary Sewer Use);"
10. Section 123, "Reinforced Concrete Pipe;"
11. Section 124, "Reinforced Concrete Pressure Pipe;"
12. Section 125, "Vitrified Clay Pipe;"
13. Section 127, "Steel Water Pipe;"
14. Section 128, "Concrete Cylinder Pipe;"
15. Section 129, "Ductile Iron Pipe;"
16. Section 130, "Gray Iron and Ductile Iron Fittings;"
17. Section 143, "Galvanizing;"
18. Section 160, "Steel Castings;"
19. Section 161, "Gray Iron Castings;"
20. Section 162, "Aluminum Castings;" and
21. Section 170, "Electronic Marker Disks."

The Contractor shall provide concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs." The Contractor shall provide steel for reinforcement in accordance with Section 540, "Steel Reinforcement."

663.2.1 Certification

The Contractor shall provide the Project Manager with a Certificate of Compliance for each required item or type of Material, before use, that indicates the item or Material is in accordance with the Contract.

663.3 CONSTRUCTION REQUIREMENTS

663.3.1 General

The Contractor shall excavate to determine the exact locations of existing utilities that affect the new construction. The Contractor shall repair damage to existing utilities due to Contractor negligence, at no additional cost to the Department.

The Project Manager will establish the final locations for new fittings, connections, etc. in the field. The Project Manager must approve modifications to the Contract in writing before use.

663.3.1.1 Waste Containment and Disposal Requirements

The Contractor shall dispose of Materials taken from sanitary sewers during cleaning operations at no additional cost to the Department.

The Contractor shall retrieve sand and other debris from the sewers and secure a legal disposal site for it.

The Contractor shall not discharge removed sewage or solids onto streets or into ditches, catch basins, or storm drains.

663.3.2 Pipe Installation

The Contractor may select a Contract-specified type of pipe as approved by the Project Manager and the Owner.

The Contractor shall store plastic pipes out of direct sunlight until placement and replace plastic pipes showing discoloration or deterioration with Acceptable pipes, at no additional cost to the Department.

The Contractor shall replace sections of pipe found to be defective before or after installation with new pipes at no additional cost to the Department.

663.3.2.1 Trenching

The Contractor shall perform trenching and excavation for utilities in accordance with Section 660, "Excavation, Trenching and Backfilling for Utilities."

663.3.2.2 Pipe Assembling

The Contractor shall perform the following before pipe assembly:

1. Clean off dirt and pipe scale;
2. Ream and remove burrs; and
3. Clear pipes and fittings of dirt, dust, and moisture.

The Contractor shall use manufacturer-recommended fittings to ensure leak-proof joints. The Contractor shall use elastomeric sealed joints in accordance with ASTM F 477 and ASTM D 3139.

The Contractor shall clean the interior of pipes from foreign matter before lowering into the trench and keep them clean during installation using plugs or other methods approved by the Project Manager.

663.3.2.3 Pipe Placement

The Contractor shall lay pipes in accordance with these *Standard Specifications* and the manufacturer's recommendations.

The Contractor shall ensure that the full length of each section of pipe rests solidly on the pipe bed including recesses to accommodate the joints. If a pipe section is disturbed after initial installation, the Contractor shall remove and re-lay.

The Contractor shall not lay pipes in water or unsuitable weather conditions. When not working on pipes, the Contractor shall securely close open ends of pipes and fittings to prevent trench water, earth, or other Deleterious Material from entering them.

663.3.2.4 Pressurized Pipe Tests

The Contractor shall thoroughly flush out main line supply pipelines and test them for leaks before placing backfill and installing valves.

The Contractor shall firmly block the fittings at bends in the pipelines and at the ends of lines to prevent the fittings from blowing off the lines when under pressure.

The Contractor shall ensure that fittings and couplings are visible for inspection during the entire test period. The Contractor shall test in accordance with NMSSPWC.

663.3.2.5 Bedding and Backfilling

The Contractor shall perform bedding and backfilling for utilities in accordance with Section 660, "Excavation, Trenching, and Backfilling for Utilities."

663.3.3 Sequence of Construction

The Contractor shall submit a proposed sequence of construction to the Project Manager for approval at least two (2) weeks before beginning the utility Work.

The Contractor shall use a sequence and method for making the connections that minimizes the inconvenience to the Owner and obtain Project Manager approval before making the connections to existing lines.

To stop the flow of water to make the connection to the existing line, the Contractor shall only close existing valves in the presence of an Owner representative.

663.3.4 Fences

The Contractor shall preserve and protect fences in the vicinity of construction.

For the relocation of utilities, the Contractor shall install temporary gates in existing fences (if necessary), if the gates are located only on rights-of-way for the utilities or at other locations for which the Contractor has obtained permission from the Owner for such construction. The Contractor shall remove temporary gates and reconstruct the fence lines to original or better condition after completing utility construction.

663.3.5 Grading and Cleanup

After backfilling, the Contractor shall grade and level the area. The Contractor shall reshape and grade Roadways to their original configurations, including restoration of drainage ditches and other features.

663.4 METHOD OF MEASUREMENT

The Department will measure pipes along the centerline of the pipe.

663.5 BASIS OF PAYMENT

The Department considers the Work described in this section to be included in the Contract.

SECTION 664: LANDSCAPE PLANTING

664.1 DESCRIPTION

This Work consists of providing trees, shrubs, and other Materials necessary to complete the landscape. This Work includes labor, Equipment, and the performance of operations including planting, fertilizing, watering, cleanup of planting areas, and replacement of unsatisfactory, damaged, and unacceptable planting Materials.

664.2 MATERIALS

664.2.1 Plant Materials

The Contractor shall provide healthy, vigorous plants of the type (species and variety) and size specified. The Contractor shall provide plants with normal, well-developed branch and root systems. The Contractor shall ensure plants are free of the following:

1. Damage from machines;
2. Sun or frost damage;
3. Insects and insect eggs; and
4. Disfiguring knots or other objectionable defects.

The Contractor shall provide plants that equal or exceed the minimum specified measurements. The Contractor shall select plant Materials for shape and branching habit; that will produce the strong, full foliage of a typical, mature specimen.

664.2.2 Inspection of Plant Materials

The Contractor shall provide plant Materials in accordance with State and federal laws, including the New Mexico Plant Protection Act (NMSA 1978, § 76-5-11 et seq.), for disease infestation inspection.

Inspection certificates required by law must accompany each shipment, invoice, or order of stock. On delivery, the Contractor shall provide the certificate to the Project Manager. The Contractor shall provide for Department inspection at the place of origin or in a local nursery, and upon delivery to the planting location at the Project.

664.2.2.1 Notification and Inspection

The Contractor shall submit an itemized list of the plants to the Project Manager, along with a time and location the inspection may be made, at least seven (7) Days in advance.

The Landscape Architect and the Project Manager will make plant inspections jointly. The Project Manager will tag the Accepted plants before plants are removed from the nursery for delivery to the Project.

The Project Manager and the Landscape Architect will inspect for size, vigor, representation of the species and variety, damage, condition of ball and roots, and latent defects.

664.2.3 Container Plants

The Contractor shall provide plants specified on the plant list as "container grown" at a reasonable stage of development for the specified container size. The Contractor shall

provide plants grown in their containers long enough to develop good, round, root systems capable of holding the soil intact after removal from the container, but not enough to become root bound.

664.2.4 Substitutions

The Department will permit substitutions of equivalent varieties of plant Materials or other Materials only after the Contractor makes every reasonable effort to secure Materials of the species, varieties, and kinds listed on the Bid Forms or in the Contract. The Contractor shall submit requests for substitutions in writing to the Project Manager for approval by the Landscape Architect. The Contractor shall obtain written approval from the Project Manager before substituting the Materials.

664.2.5 Delivery of Shipment to Site

The Contractor shall protect plant Materials before shipment to prevent damage (over-drying or wind). The Contractor shall be careful when digging, wrapping, and binding plants to ensure safe loading, shipment, and handling of heavy balled plants.

The Contractor shall notify the Project Manager of the time and manner of delivery at least seven (7) Days in advance. The Contractor shall provide two (2) copies of an itemized list of the quantities of plant Materials in each delivery with the notice.

The Project Manager will inspect the plants upon delivery. The Department will reject cracked or mushroomed balls and damaged plants that are unacceptable for planting. The Contractor shall immediately remove rejected plants from the Project.

664.2.6 Tagging and Labeling of Plant Materials

The Contractor shall securely tag plants with legible, durable labels using weather-resistant ink and identifying the following for each plant:

1. Origin;
2. Species;
3. Variety;
4. Name; and
5. Size.

The Contractor shall keep tags on through final inspection.

664.2.7 Fertilizer

The Contractor shall provide fertilizer in accordance with the Contract.

664.2.8 Water

The Contractor shall use clean water that is free from pollutants harmful to plant growth or that could contaminate the environment.

664.3 CONSTRUCTION REQUIREMENTS

664.3.1 Planting

The Contractor shall use the planting backfill mixture and provide watering basins in

accordance with Contract. The Contractor shall not plant deeper than the original ground line.

664.3.2 Care and Replacement

During any period of suspension of Work, the Contractor shall properly and continuously maintain in a growing condition all plant Material in newly installed plantings furnished under the Contract. The Contractor shall take adequate precautions to protect new plant growth against any injury.

If the Contractor installs an irrigation system, the Contractor shall hand water the plants until the irrigation system is in place and operational.

664.3.3 Final Inspection and Acceptance

After the completion of the landscape planting Work, the Project Manager and Landscape Architect will make final inspection and Acceptance.

664.4 METHOD OF MEASUREMENT

The Department will measure the actual number of trees, shrubs, or other plants provided, planted, and Accepted.

664.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Landscape Complete</i>	Lump Sum

664.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Furnishing, transporting, and planting of plants; and
2. Excavation, furnishing prepared backfill mixture, wrapping, staking, watering, care, weeding and maintenance; of plants.

SECTION 667: REST AREA AND MISCELLANEOUS ITEMS

667.1 DESCRIPTION

This Work consists of providing and constructing rest area items and miscellaneous improvements.

667.2 MATERIALS

667.2.1 Portland Cement Concrete

The Contractor shall provide portland cement and aggregate for concrete in accordance with Section 509, "Portland Cement Concrete Mix Designs."

667.2.2 Steel

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement." The Contractor shall provide anchor bolts for mailbox installations in accordance with ASTM A 307 Grade A steel.

The Contractor shall provide zinc coated anchor nuts and bolts.

667.3 CONSTRUCTION REQUIREMENTS

The Contractor shall construct Work in accordance with the applicable local and State codes, ordinances, and regulations governing the particular class of Work involved.

If there is a conflict between the applicable codes and the requirements in the Contract, the Contractor shall use the more stringent requirements.

After completing the Work, the Contractor shall clean the areas of debris and leave them in their existing or an improved condition.

667.3.1 Mailbox Installations

The Contractor shall install mailboxes in accordance with AASHTO's "A Guide for Erecting Mail Boxes on Highways."

The Contractor shall contact and coordinate with the local post office and property owner before removing old mailboxes and installing new mailboxes. The Contractor shall provide and install temporary mailboxes, if necessary, as directed by the Project Manager.

667.4 METHOD OF MEASUREMENT

The Department will measure special landscaping items by units specified in the Contract.

667.4.1 Measurement Clarifications

A single mailbox installation consists of one (1) mailbox and one (1) mailbox support.

A double mailbox installation consists of two (2) mailboxes and one (1) mailbox support. Multiple mailbox installations consist of from three (3) to 16 mailboxes and one (1) mailbox support. A picnic table unit consists of one (1) picnic table and two (2) benches.

667.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Timber Parking Barriers</i>	Each
<i>Charcoal Grills</i>	Each
<i>Park Benches</i>	Each
<i>Picnic Shelters</i>	Each
<i>Picnic Table Pads</i>	Each
<i>Picnic Tables and Benches</i>	Each
<i>Litter Receptacles</i>	Each
<i>Historical Markers</i>	Each
<i>Skylights</i>	Each
<i>Mirrors</i>	Each
<i>Storage Buildings</i>	Each
<i>Air Systems</i>	Each
<i>Water Closets</i>	Each
<i>Lavatories</i>	Each
<i>Urinals</i>	Each
<i>Mailbox Installation (Single)</i>	Each
<i>Mailbox Installation (Double)</i>	Each
<i>Mailbox Installation (Multiple)</i>	Each
<i>Rest Room Buildings</i>	Lump Sum
<i>Sanitary Sewer System Improvements</i>	Lump Sum
<i>Picnic Shelter Renovation</i>	Lump Sum
<i>Corrals</i>	Lump Sum
<i>Post and Cable Barriers</i>	Linear Foot
<i>Glazed Wall Tiles</i>	Square Yard
<i>Glazed Roofing</i>	Square Yard

If the Contract specifies a mailbox support foundation and anchoring only, the Department will pay for the concrete and steel in accordance with Section 511, "Concrete Structures," and Section 540, "Steel Reinforcement."

667.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Labor, tools, Equipment, and appurtenances necessary to satisfactorily complete the Work as approved by the Project Manager;
2. Removal and disposal of shrubs, brush, rocks, or other obstacles that interfere with proper installation of the improvements;
3. Concrete slabs, steel anchor devices, reinforcement, and foundations for rest area items;
4. Coordination with the local post office and property owner;
5. Removal of existing mailboxes; and

6. Removal and installation of temporary mailboxes.

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SECTION 701: TRAFFIC SIGNS AND SIGN STRUCTURES

701.1 DESCRIPTION

This Work consists of providing and installing traffic signs and sign Structures in accordance with the *MUTCD, current edition*

701.2 MATERIALS

701.2.1 Concrete

The Contractor shall use Class G concrete for overhead sign structure foundations in accordance with Section 502, "Drilled Shafts."

The Contractor shall use Class A concrete for extruded panel sign foundations in accordance with Section 510, "Portland Cement Concrete."

701.2.2 Steel Reinforcement

The Contractor shall use steel reinforcement in accordance with Section 540, "Steel Reinforcement."

701.2.3 General

The Contractor shall provide Materials manufactured in accordance with the requirements of ASTM D 4956, current version.

701.2.3.1 Sign Manufacturer's Quality Control

The Contractor shall manufacture permanent signs in accordance with a Quality Control (QC) program approved and certified by the Traffic Services Engineer before fabrication.

The Contractor shall ensure the QC program includes the following:

1. Basis of raw Material Acceptance:
 - 1.1 Sign manufacturer Certificates of Compliance for sign Materials; or
 - 1.2 Random lot testing and certification of sign Materials by an independent testing Laboratory (ITL); and
 - 1.3 Traffic Services Engineer's approval of methods of manufacture;
2. Type, method, and frequency of control tests;
3. A record of QC program data for each sign component as follows:
 - 3.1 Maintain a logbook or other approved form of documentation that cross-references sign certifications. Include certifications for each sign component Material lot used to make each sign. Maintain these records for at least three (3) years;
 - 3.2 File and cross-reference any special instructions on how to use sign Materials, such as substrate preparation before applying sign sheeting or use of special inks;
4. Final inspection:
 - 4.1 Provide a manufacturing checklist for signs. Identify all sign component Material lot numbers and cross-reference those with the manufacturer's or ITL's Certificates of Compliance;

- 4.2 Provide a completed checklist to the Project Manager with each sign shipment;
and
5. Name and position of the Quality Control person.

701.2.3.2 De-certification of Quality Control Program

The Department may withdraw approval of a sign manufacturer's QC program, if the manufacturer fails to follow the certified written QC program or fabricates signs that do not conform to Department Specifications. The Traffic Services Engineer or designee will determine the de-certification period based on the severity and nature of infractions.

The Department may prohibit the use of sign manufacturers that do not have a certified QC program. However, the Traffic Services Engineer may allow the sign manufacturer to supply signs under the following conditions when the QC program certification has been withdrawn:

1. The sign manufacturer shall hire an ITL to inspect the manufacture of signs to be used on Department Projects, as approved by the Department; and
2. The ITL shall have a certified Quality Control program. The ITL shall provide a checklist in accordance with the certified QC program to the Project Manager indicating the signs were inspected and in accordance with the Specifications.

The Traffic Services Engineer or designee may recertify sign manufacturers, if they meet Department requirements.

701.2.3.3 Verification of Manufacturer's Certification

The Contractor shall submit the name of the proposed sign manufacturer and Project number in writing. The Traffic Services Section will verify that the proposed sign manufacturer is eligible to supply signs to the Project.

701.2.3.4 Sign Identification

The Contractor shall ensure that signs have identification labels as follows:

1. Display the following Information on the manufacturer's identification label:
 - 1.1 The wording, "Manufactured By," followed by the sign Fabricator's initials;
 - 1.2 Month and year fabricated;
 - 1.3 Reflective sheeting type and manufacturer's initials;
 - 1.4 The statement, "Property of the State of New Mexico, Defacing or Theft is a Crime;" and
 - 1.5 Whether sign is laminated with anti-graffiti sheeting;
2. Display the following Information on the Contractor's identification label:
 - 2.1 Contractor's name; and
 - 2.2 Date installed (month and year).

The labels may be dye stamped in 3/8 inch letters and numerals, or 1/2 inch letters and numerals made with high-tack adhesive reflective or non-reflective sign sheeting, prepared with screened ink. The Contractor shall place labels on the lower backside of the sign, where not hidden by any post or frame member. The Contractor shall provide labels with weather resistance characteristics having a service life at least equal to that of the sign. The Contractor shall not damage signs during die stamping.

701.2.3.5 Special Coded Signs

At the Pre-Construction meeting, the Contractor shall submit detail drawings to the Project Manager for review and approval by the State Traffic Technical Support Engineer for any special signs that significantly deviate from Plan Drawing dimensions or that, which is contrary to latest edition of the MUTCD.

Detailed drawings must show the complete legend, arrangement of letters and numerals, letter and numeral height, letter series, symbols, borders, and dimensions. The Contractor shall not manufacture special signs until the Department has reviewed and approved submitted sign drawings.

701.2.4 Sign Components

701.2.4.1 Retroreflective Sheeting

The Contractor shall use retroreflective sheeting included in the Department’s *Approved Products List*. The Contractor shall provide certification that sheeting is in accordance with ASTM D 4956, current version. The Contractor shall provide sheeting that has a smooth, flat exterior film with retroreflective elements homogeneous in appearance, weather resistant, and with a protected, pre-coated adhesive backing.

The Contractor shall use Type XI retroreflective sheeting for all signs with the following exceptions:

- 1. Recreational, cultural interest, general service, and specific service signing shall have a minimum Type IV retroreflective sheeting.

701.2.4.1.1 Colors

The Contractor shall provide the diffuse Day color of the retroreflective sheeting in accordance with ASTM D 4956, current version, Table 13.

701.2.4.1.2 Coefficient of Retroreflection

The Contractor shall provide sign sheeting with a coefficient of retroreflection, expressed as Specific Intensity per unit area, or average candlepower per foot-candle per square foot. The Contractor shall ensure the intensity values meet at least the minimum values at 0.2° and 0.5° observation (divergence) angles, and, when specified in the Contract, at least the minimum values at 0.1° and/or one degree (1.0°) Observation Angles. The Contractor shall ensure intensity values are in accordance with Table 701.2.4.1.2:1, “Type IV Sheeting - Unmetallized Microprismatic Element,” Table 701.2.4.1.2:2, “Type VIII F Sheeting –

Fluorescent Microprismatic Lens,” Table 701.2.4.1.2:3, “Type IX Sheeting - Microprismatic Lens,” Table 701.2.4.1.2:4, “Type IX F Sheeting - Fluorescent Microprismatic Element,” and Table 701.2.4.1.2:5, “Type XI Retroreflective Sheeting.” The Contractor shall conduct testing methods in accordance with ASTM E 810.

**Table 701.2.4.1.2:1
Type IV Sheeting - Unmetallized Microprismatic Element**

OA	EA	White	Yellow	Orange	Red	Green	Blue	Brown
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Table 701.2.4.1.2:1
Type IV Sheeting - Unmetallized Microprismatic Element

OA	EA	White	Yellow	Orange	Red	Green	Blue	Brown
0.2	-4	360	270	145	65	50	30	18
0.2	+30	170	135	68	30	25	14	8.5
0.5	-4	150	110	60	27	21	13	7.5
0.5	+30	72	54	28	13	10	6	3.5

Table 701.2.4.1.2:2
Type VIII F Sheeting - Fluorescent Microprismatic Lens

Minimum reflectivity for fluorescent sheeting (average candle power per foot candle per square foot)

OA	EA	Orange
0.1	-4	300
0.1	+30	135
0.2	-4	210
0.2	+30	95
0.5	-4	75
0.5	+30	35

Table 701.2.4.1.2:3
Type IX Sheeting - Microprismatic Lens

Minimum reflectivity (average candlepower per foot candle per square foot)

OA	EA	White	Orange	Yellow	Red	Green	Blue
0.2	-4	380	145	285	76	38	17
0.2	+30	215	82	162	43	22	10
0.5	-4	240	90	180	48	24	11
0.5	+30	135	50	100	27	14	6.0
1.0	-4	80	30	60	16	8.0	3.6
1.0	+30	45	17	34	9.0	4.5	2.0

Table 701.2.4.1.2:4
Type IX F Sheeting - Fluorescent Microprismatic Element

Minimum reflectivity (average candle power per foot candle per square foot)

OA	EA	Yellow	Yellow/Green
0.2	-4	230	300
0.2	+30	130	170
0.5	-4	145	190
0.5	+30	81	110
1.0	-4	48	64

**Table 701.2.4.1.2:4
Type IX F Sheeting - Fluorescent Microprismatic Element**

		Minimum reflectivity (average candle power per foot candle per square foot)	
OA	EA	Yellow	Yellow/Green
1.0	+30	27	36

**Table 701.2.4.1.2:5
Type XI Retroreflective Sheeting**

Minimum reflectivity (average candle power per foot candle per square foot)											
OA	EA	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1	-4	830	620	290	83	125	37	25	660	500	250
0.1	+30	325	245	115	33	50	15	10	260	200	100
0.2	-4	580	435	200	58	87	26	17	460	350	175
0.2	+30	220	165	77	22	33	10	7.0	180	130	66
0.5	-4	420	315	150	42	63	19	13	340	250	125
0.5	+30	150	110	53	15	23	7.0	5.0	120	90	45
1.0	-4	120	90	42	12	18	5.0	4.0	96	72	36
1.0	+30	45	34	16	5.0	7.0	2.0	1.0	36	27	14

701.2.4.1.3 Retroreflective Sheeting Backing

The Contractor shall provide backing for sheeting Types IV through XI in accordance with ASTM D 4956, current version.

701.2.4.1.4 Retroreflective Sheeting Durability and Workmanship

The Contractor shall use retroreflective sheeting Material in accordance with ASTM D 4956, current version. The Contractor shall provide sheeting Material sufficiently strong and flexible enough for handling, processing, and application in accordance with the manufacturer's recommendations without stretching.

When processed and applied in accordance with recommended procedures, sheeting Material must be weather resistant and, following cleaning, must show no discoloration, cracking, blistering, or dimensional change.

When exposed to normal traffic and weather, sheeting Material must not support fungus growth or accumulate dirt that reduce brightness before cleaning to less than 75% of the brightness after cleaning, measured at 0.2° divergence and negative four degrees (-4°) incidence.

The Contractor shall use a sheeting surface that can be refurbished by cleaning and clear protective overcoating in accordance with manufacturer's recommendations.

The Contractor shall apply retroreflective sheeting to a treated substrate, as recommended by the manufacturer. The Contractor shall ensure finished signs have a smooth and uniform surface and that letters and numbers are clean-cut and sharp.

The Contractor shall ensure the sheeting surface is solvent resistant and can be cleaned with a soft, clean cloth dampened with VM & P naphtha or mineral spirits.

701.2.4.1.5 Retroreflective Sheeting Delivery and Handling

If the Contractor provides retroreflective sheeting in continuous rolls, the Contractor shall ensure splices are smooth with no discernible lines and that sheeting is suitable for continuous application.

The Contractor shall use sheeting within the manufacturer's recommended time frame.

701.2.4.1.6 Multiple Pieces of Sign Sheeting

The Contractor shall ensure that sign faces from two (2) or more pieces of retroreflective sheeting match in color and provide uniform appearance and brilliance by Day and night.

The Contractor shall cover sign panels less than 48 inches tall with one (1) unspliced sheet of retroreflective sheeting. The Department will allow a horizontal splice, only if the substrate panel is 48 inches or taller. The Contractor shall ensure sheet colors match.

Sheeting shall be butt spliced when more than one (1) piece of sheeting is used on one (1) piece of substrate per manufacturer's recommendations. The sheeting pieces should not touch each other.

701.2.4.1.7 Screening Inks

The Department will allow use of screening inks, or acrylic film overlays recommended by the retroreflective sheeting manufacturer, instead of manufactured colors to produce the legend and background. The Contractor shall submit the manufacturer's recommendations, in writing, to the Department. The Contractor shall file a copy of the recommendations in accordance with Section 701.2.3.1, "Sign Manufacturer's Quality Control."

The Contractor shall use ultraviolet (UV) resistant inks requiring no additional clear coating or UV protection. The Contractor shall use inks that are one (1) part non-isocyanate Material, easily removed from sign screens with citrus-based environmentally friendly screen cleaning solvents.

701.2.4.1.7.1 Outdoor Weatherability

The Contractor shall use screening inks, or acrylic film overlays with weather-resistant properties equal to retroreflective sheeting.

701.2.4.1.7.2 Adherence

To test for screening ink, process paste, or film overlay adherence, the Contractor shall apply cellophane recording to a cured color processed area, and remove the recording with one (1) quick motion; no ink, paste, or film overlay should come off. The Contractor shall use 3/4 inch wide Cellophane Recording for this test.

701.2.4.1.7.3 Solvent Resistance

After curing, the Contractor shall ensure sign faces resist manufacturer recommended cleaning solvents.

701.2.4.1.7.4 Vandal Resistance

The Contractor shall ensure that sign faces resist manufacturer recommended aromatic solvents used to remove paint or other oil based matter sprayed or painted on signs.

701.2.4.1.7.5 Color

The Contractor shall use a sign face color in accordance with ASTM D 4956, current version.

701.2.4.1.7.6 Retroreflective Intensity (Transparent Colors)

The Contractor shall process and apply transparent colored inks or transparent colored acrylic film overlays in accordance with the sheeting manufacturer's recommendations.

The Contractor shall ensure that the transparent color area processed on white sheeting provides a minimum retroreflective intensity value of at least 70% of the values specified in Table 701.2.4.1.2:1, "Type IV Sheeting - Unmetallized Microprismatic Element," Table 701.2.4.1.2:2, "Type VIII F Sheeting - Fluorescent Microprismatic Lens," Table 701.2.4.1.2:3, "Type IX Sheeting - Microprismatic Lens," Table 701.2.4.1.2:4, "Type IX F Sheeting - Fluorescent Microprismatic Element," and Table 701.2.4.1.2:5, "Type XI Retroreflective Sheeting," for each color at 0.2° OA and negative four degrees (-4°) EA (or 0.1° and/or 1.0° Observation Angles if, specified in the Contract).

701.2.4.1.7.7 Process Colors on Sheeting

The Contractor shall ensure the retroreflective intensity values are 70% of the retroreflective values specified in Section 701.2.4.1.2, "Coefficient of Retroreflection." Corresponding values at 0.2° OA and negative four degrees (-4°) EA are included in Table 701.2.4.1.7.8:1, "Retroreflective Intensity per Process Color."

701.2.4.1.7.8 Process Inks

The Contractor shall ensure that process inks equal 70% of the coefficient of retroreflection of new sheeting and 70% at the end of the warranty period.

**Table 701.2.4.1.7.8:1
Retroreflective Intensity per Process Color**

Type of sheeting	Intensity Value (average candelas per foot candle per square foot)		
	Red	Blue	Green
Type IV Unmetallized Microprismatic Element	24.5	14.0	24.5
Type IX Microprismatic Element	53.2	11.9	26.6
Type XI Retroreflective Sheeting	60.9	18.2	40.6

701.2.4.2 Sign Legends and Sheeting

A sign legend shall contain such letters, numerals, symbols, arrows, borders, and other accessories that convey the sign's message.

Sign legend, background and protective overlay film shall be of the same type in accordance with Section 701.2.4.1, "Retroreflective Sheeting." If a UV or anti-graffiti protective overlay film is used, it should be manufacturers match component Materials and retain manufactures standard warrantees.

The Contractor shall provide legends in accordance with *MUTCD, current edition*. The legend may be:

1. 0.005 in minimum thickness integral, semi-rigid;
2. Self-adhering, machine cut sheeting; or
3. Reverse screened using weatherproof screen process inks compatible with the background that provides the designated sign colors and retroreflectorization; or a reverse film overlaid with an approved acrylic film overlay.

The Contractor shall provide extruded panel signs with borders as follows:

1. 1 1/8 inch wide with six (6) inch corner radii for signs under six (6) feet tall;
2. Two (2) inch wide with nine (9) inch corner radii for signs from six (6) feet to 7.5 feet tall; or
3. Three (3) inch wide with 12 inch corner radii for signs over 7.5 feet tall.

701.2.4.3 Sign Backgrounds

The Contractor shall provide a sign face with a plane surface free from defects. The Department may reject the entire sign face because of a defect or because of a dirty, marred, or defective background or legend. The Department will inspect in place signs at night for compliance.

701.2.4.4 Aluminum Panel Signs

The Contractor shall use 0.125 inch minimum thickness 6061-T6 or 5052-H38 aluminum alloy for signs.

The Contractor shall provide aluminum alloys in accordance with ASTM B 209. The Contractor shall supply as flat stock Material. The Contractor shall provide aluminum panel signs with smooth edges and corners.

701.2.4.4.1 Corners

The Contractor shall cut corner radii in accordance with the FHWA Standard Highway Signs manual.

701.2.4.4.2 Aluminum Sign Substrate

The Contractor shall prepare aluminum sign substrate for retroreflective sheeting as specified by the sheeting Material manufacturer. The Contractor shall apply sheeting, legend, and clear coat in accordance with the manufacturer's recommendations. The Contractor shall keep a copy of the manufacturer's recommendations on file as specified in Section 701.2.3.1, "Sign Manufacturer's Quality Control."

The Contractor shall punch or drill a hole in the aluminum sign panel to receive tamper proof hardware.

701.2.4.5 Extruded Panel Signs

The Contractor shall use extrusion-type signs, if mounted on steel I-Beam posts or on overhead sign Structures.

701.2.4.5.1 Aluminum Extrusions

The Contractor shall use 6063-T6 aluminum alloy in accordance with ASTM B 221, provided in 12 inch or six (6) inch sections in accordance with the Contract.

701.2.4.5.2 Sign Fabrication for Extruded Panel Signs

Sign legend and background for Extruded Panel Signs shall be fabricated on a .063 thick aluminum overlay panel. Aluminum overlay panel shall be riveted to the aluminum extrusion panel to complete the extruded sign unless a digital printing process is used.

For sign legend and copy, the Contractor shall submit detail drawings to the Project Manager for review and approval of the State Traffic Technical Support Engineer as per Specifications in Section 701.2.3.5, "Special Coded Signs."

701.2.4.5.3 Aluminum Overlay Panel Fabrication

Aluminum overlay panels shall contain the sign legend and background.

The flatness tolerance for an installed panel is 1/32 inch per foot of length and 0.004 inch per inch of width.

For aluminum overlay panels, the Contractor shall use panel units two (2) feet to four (4) feet wide, installed vertically. The Contractor shall not horizontally splice metal facing sign panels eight (8) ft tall or less.

For horizontal splices on signs taller than eight (8) feet, the Contractor shall offset the metal facing splices from the corresponding extrusion joint by 1/2 inch to one (1) inch.

For aluminum overlay panels, the Contractor shall use a sheet of aluminum 6061-T6 or 5052-H38 alloy in accordance with ASTM B 209, supplied as flat stock Material with a minimum thickness of 0.060 inch.

701.2.4.5.4 Digitally Printed Signs

Signs manufactured using digital printing process with a protective overlay film to produce all or part of the image shall conform to all other requirements of Section 701, "Traffic Signs and Sign Structures" with the exception that for extruded panel signs, reflective sheeting may be adhered directly to aluminum extrusions and aluminum overlay panels do not have to be used.

For digitally printed extruded panel signs without aluminum overlay panels, all or part of the image shall be printed on the required sheeting which then shall be laminated to the aluminum extrusion, and assembled together to finish the extruded panel sign.

For digitally printed aluminum panel signs, overlay panels or extruded panel signs, all or part of the image may be printed before or after the sheeting is laminated to the panel.

701.2.4.5.4.1 Outdoor Weathering of Digitally Printed Signs

Inks applied using digital printing processes with a protective overlay film shall produce standard traffic colors (green, yellow, red, blue, brown, black) and have outdoor weathering properties equal to that of the base reflective sheeting.

701.2.4.5.4.2 Standard Traffic Colors Digitally Printed

Standard traffic colors (green, yellow, red, blue, brown, and black) printed with digital printing technology with a protective overlay film must provide the diffuse daytime color of the retroreflective sheeting in accordance with ASTM D4956-09, current version, Table 11.

701.2.4.5.4.3 Retroreflective Intensity of Digitally Printed Standard Traffic Colors

The coefficient of retro reflection of the standard traffic colors (green, yellow, red, blue, brown, and black) digitally produced on white or yellow sheeting shall provide an initial minimum retroreflective intensity as specified in Section 701.2.4.1.7.6, "Retroreflective Intensity (Transparent Colors)."

701.2.4.5.5 Extrusion Hardware

The Contractor shall use 2025-T4 aluminum alloy extrusions for hardware with an alumilite or alodine finish, in accordance with ASTM B 221.

701.2.4.6 Inspection

The Department may inspect Material and finished signs before and after installation at the Project site.

The Contractor shall ensure that the Department has free entry to plant areas involved in sign manufacture and production during Work hours. The Contractor shall provide adequate facilities for the Department to inspect signs and verify the manufacturer's QC program.

On request, the Contractor shall provide 12 inch × 12 inch test panels representing each production stage to the Inspector. The Contractor shall produce the test panels during regular production in the presence of the Inspector. If the Inspector cannot validate that the test panel came from regular production, the Contractor shall provide a complete sign, upon request.

701.2.4.7 Packaging and Shipping

The Contractor shall package and protect signs and hardware for shipment and storage.

701.2.5 Aluminum Overlay Panels for Existing Extruded Signs

The Contractor shall provide retroreflective sheeting overlay panels that consist of a retroreflectorized face sheet fastened with rivets over an existing extruded sign.

Overlay panel shall be constructed with:

1. 6061-T6 or 5052-H38 aluminum sheet alloy, in accordance with ASTM B 209, a minimum of 0.063 inch thickness. And the Contractor shall use latest Departments Sign Sheeting Requirements for reflective sheeting.

The Contractor shall install overlay panels in accordance with Section 701.2.4.2, "Sign Legends and Sheeting." The Contractor shall remove and repair the existing legend, as directed by the Project Manager.

701.2.6 Sign Structures and Hardware

The Contractor shall select aluminum panel sign and base posts from the Department's *Approved Products List*. The Contractor shall install posts in accordance with NCHRP *Report 350* and/or MASH criteria for single and multiple-post installations, and with the post manufacturer's wind load chart. The Contractor shall supply Certificates of Compliance to the Project Manager.

The Contractor shall use one (1) of the following finishes:

1. Hot dipped galvanizing in accordance with ASTM A 653 or ASTM A 123;
2. Hot dip galvanized zinc coating, in accordance with AASHTO M 120, followed by a chromate conversion coating and a cross-linked polyurethane acrylic exterior coating; or
3. Color No. 17038 black paint or Color No. 14109 green paint for U-channel posts. The Contractor shall provide paint in accordance with Federal Standard 595a, a minimum of one (1) mil thick.

701.2.6.1 Post Assembly Hardware

The Contractor shall use post assembly hardware that is:

1. Hot dipped galvanized or cadmium plated in accordance with ASTM B766-86;
2. Stainless steel; or
3. Mechanically galvanized in accordance with ASTM B545 (Class Fe/Sn 20).

701.2.6.2 Fasteners

The Contractor shall use size M8 tamper-proof carriage bolts to attach signs that are:

1. Hot dipped galvanized, or cadmium plated in accordance with ASTM B766-86;
2. Stainless steel; or
3. Mechanically galvanized in accordance with ASTM B 545 (Class Fe/Sn 20).

The Contractor may use rivets to attach signs. The Contractor shall follow manufacturer's recommendations for installation procedures.

The Contractor shall use size M8 tamper-proof nuts fabricated from C 1008 hot rolled steel, case hardened to R55-60, and plated with zinc yellow dichromate, from 0.002 inch to 0.005 inch thick.

701.2.6.3 Posts for Extruded Panel Signs

The Contractor shall fabricate I-beam posts for extruded panel signs from standard Structural Steel shapes in accordance with ASTM A 36. The Contractor shall use one (1) of the following finishes:

1. Hot dipped galvanizing in accordance with the requirements of ASTM A 123;
2. Cold galvanizing in accordance with the fabrication method approved by the Traffic Services Engineer; or
3. Coating in accordance with Section 545, "Protective Coating of Miscellaneous Structural Steel."

The Contractor shall use posts with fuse plate mechanisms.

701.2.6.4 Overhead Sign Structures

The Contractor shall fabricate overhead sign Structures as specified in the Department approved drawings.

701.2.6.5 Breakaway Base Systems

The Contractor shall use Breakaway base systems that include slip-type connection, hardware, and stub post as specified in the Contract Plan set.

701.2.6.6 Fabrication

701.2.6.6.1 Shop Drawing Submittals & Review

The Contractor shall submit detailed extruded panel sign post shop drawing for ground mounted extruded signs and or detailed overhead sign Structure shop drawings for approval before fabrication.

The Department will review overhead sign Structure shop drawings. The Contractor shall not fabricate extruded sign posts or overhead Structures until the Department has reviewed and approved the shop drawings for the I-beam posts and or the overhead Structures.

701.2.6.6.2 General Fabrication Requirements

The Contractor shall ensure arrangement, letter spacing and height, letter series, symbols, and borders for each sign face are in accordance with the *FHWA Standard Highway Signs* manual and/or current edition of MUTCD.

The Contractor shall shear, blank, saw, or mill Material 1/2 inch thick or less. The Contractor shall saw or mill Material over 1/2 inches thick.

The Contractor shall ensure that cut edges are true, smooth, and free from excessive burrs or ragged breaks. The Contractor shall fillet re-entrant cuts by drilling before cutting. Flame cutting is prohibited.

The Contractor shall drill bolt holes to finish sizes.

The Contractor shall shop assemble extrusions, overlay panels, and legend items. The Contractor shall ensure that overlay panels are tightly butted together. The Contractor shall use additional fasteners, as needed, to achieve flatness. The Contractor may deliver assembled signs more than eight (8) ft high in two (2) parts.

701.2.6.6.3 Fabrication Requirements for Contact Surfaces

The Contractor shall use galvanized or stainless steel for surfaces in contact with aluminum.

The Contractor shall coat aluminum surfaces in contact with concrete or earth with an alkali resistant asphalt paint in accordance with manufacturer's recommendation.

701.3 CONSTRUCTION REQUIREMENTS

701.3.1 General

The Contractor shall deliver removed, existing traffic control signs to locations specified in

the Contract, or as directed by the Project Manager. The Contractor shall document removals and deliveries in the Traffic Control Diary in accordance with Section 618, "Traffic Control Management."

701.3.1.1 Installation of Breakaway Sign Posts

The Contractor shall ensure that slope and other Material does not interfere with the proper functioning of installed sign Breakaway systems.

701.3.1.2 Manufacturer Certification Verification

The Contractor shall supply signs with identification on the back as specified in Section 701.2.3.4, "Sign Identification," that matches the approved sign manufacturer identified by the documentation letter.

The Contractor shall not install permanent signs until the Project Manager has:

1. Verified that the sign shipment has a manufacturer's checklist; and
2. Given authorization to begin sign installations.

The Contractor shall use the manufacturer for which certification was requested.

701.3.2 Site Storage Requirements

The Contractor shall elevate stored Materials from the ground and surface runoff water. The Contractor shall store signs posts and hardware away from pavement or Shoulder.

701.3.3 Installation Requirements

The Contractor shall compact sign Structure footing foundations and backfill to 95% of maximum density as determined by AASHTO T 180 (Modified Proctor), Method D (TTCP Modified).

The Contractor shall set posts plumb. The Contractor shall ensure that the mounting faces of multiple sign posts lie in the same plane.

701.3.4 Reserved

701.3.5 Removing and Resetting Traffic Signs

The Contractor shall remove existing traffic signs, posts, and associated appurtenances from specified locations and reset on new posts with new hardware redesigned for existing conditions, in accordance with Section 618, "Traffic Control Management."

Before removing existing signs, the Contractor shall submit a sign removal and resetting schedule to the Project Manager for approval.

701.3.5.1 Removing and Resetting Extruded Panel Signs

The Contractor shall remove specified existing extruded panel signs, I-beam posts, and footing, and dispose of the Materials in an environmentally Acceptable manner. The Contractor shall stockpile removed I-beam posts at locations specified in the Contract. The Contractor shall reset removed extruded panel signs on new I-beam posts and Breakaway base systems using new hardware in accordance with Section 701.2.6.3, "Posts for Extruded Panel Signs," and Section 701.2.6.5, "Breakaway Base Systems." The Contractor shall

design new extruded panel sign posts, new Breakaway base systems, and new hardware for existing conditions in accordance with the manufacturer's recommendations and as specified in the Contract.

The Contractor shall backfill holes left by the removal of extruded panel sign post footings and compact in accordance with Section 203, "Excavation, Borrow, and Embankment."

701.3.6 Mileposts Installation

The Contractor shall notify the Project Manager two (2) weeks before placing mileposts; the District Traffic Engineer will mark the milepost locations.

701.4 METHOD OF MEASUREMENT

The Department will not measure that portion of *Steel I-Beam Posts* extending below ground level.

The Department will not include stub post lengths in the measurement of *Steel I-Beam Post* lengths.

701.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Extruded Panel Signs</i>	Square Foot
<i>Panel Signs</i>	Square Foot
<i>Overhead Sign Structure, Type _____, Size _____</i>	Each
<i>Steel I-Beam Posts, Type _____ x _____</i>	Linear Foot
<i>Breakaway Base System for Steel I Beam Post _____ x _____</i>	Each
<i>Steel Posts & Base Posts for Aluminum Panel Signs</i>	Foot
<i>Multi-Directional Slip Base Posts for Aluminum Panel Signs</i>	Each
<i>Retroreflective Sheeting Field Overlay Panels</i>	Square Foot
<i>Remove and Reset Traffic Sign</i>	Each
<i>Remove and Reset Panel Sign</i>	Each
<i>Remove and Reset Extruded Panel Sign</i>	Each

The Department will pay for overhead sign structure foundation installations in accordance with Section 502, "Drilled Shafts."

The Department will pay for steel reinforcement used for overhead sign structure foundations in accordance with Section 540, "Steel Reinforcement."

701.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Hardware;
2. Excavation, backfill, and compaction for installation;
3. Excavation, backfill, and compaction for removed extruded panel sign footings;
4. Reinforcing steel for extruded panel sign foundations;

5. Class A Concrete for extruded panel sign foundations and multi-directional slip base posts;
6. Hauling and disposal of removals; and
7. Hauling and stockpile of salvageable Materials.

SECTION 702: CONSTRUCTION TRAFFIC CONTROL DEVICES

702.1 DESCRIPTION

This Work consists of providing and installing construction traffic control devices.

702.2 MATERIALS

702.2.1 Construction Signing

The Contractor shall provide sign substrate sufficiently durable to last the Project duration and rigid enough to hold the sheeting flat.

The Contractor shall provide Materials in accordance with Section 701.2.4.1, "Retroreflective Sheeting;" Section 701.2.4.2, "Sign Legends and Sheeting;" and Section 701.2.4.3, "Sign Backgrounds."

The Contractor shall provide Type VIII or greater retroreflective sheeting for construction signing, flagger paddle, drums, cones, and channelization devices for legends and sign backgrounds, unless otherwise specified in the Contract.

The Contractor shall use black letters on a reflective fluorescent orange background for construction signing, unless otherwise specified in the Contract.

The Contractor shall provide Type XI or greater intensity retroreflective sheeting for background of regulatory signs.

702.2.1.1 Steel Posts and Base Posts for Construction Signing

The Contractor shall provide steel post and base post Material in accordance with Section 701.2.6, "Sign Structures and Hardware."

702.2.1.2 Portable Sign Supports

The Contractor shall provide portable sign supports in accordance with the *MUTCD*, *current edition* and the Department's *Approved Products List*.

702.2.2 Barricades and Channelization Devices

The Contractor shall provide traffic control devices in accordance with the Department's *Approved Products List* for barricades and channelization devices, available from the State Maintenance Bureau.

Suppliers proposing traffic control devices for inclusion on the Department's *Approved Products List* must submit product certifications for approval. The Department will review and approve or deny the proposed certifications within 30 Days.

Unless stated otherwise, the Contractor shall submit, to the Project Manager, certification from the manufacturer stating that the traffic control devices proposed for use are in accordance with *NCHRP Report 350 and/or MASH*. The Contractor shall submit certification showing that the proposed traffic control devices are listed on the Department's *Approved Products List*.

The Contractor shall use traffic control devices from the following categories:

1. Category I Traffic Control Devices. Low mass, single piece traffic cones; tubular markers; pedestrian devices; single-piece drums; delineators; or similar devices without lights or signs.
2. Category II Traffic Control Devices. Vertical panels; Type I, II, and III barricades; temporary ADA pedestrian devices; moveable skid mounted sign stands; or similar devices.

702.2.2.1 Barricades

The Contractor shall use reflectorized barricades with orange and white retroreflective sheeting or recording in accordance with the *MUTCD, current edition* and Table 701.2.4.1.2:1, "Type IV Sheeting - Unmetallized Microprismatic Element," and Table 701.2.4.1.2:2, "Type VIII F Sheeting - Fluorescent Microprismatic Lens."

702.2.2.2 Vertical Panels

The Contractor shall use reflectorized vertical panels with orange and white retroreflective sheeting or recording in accordance with the *MUTCD, current edition* and Table 701.2.4.1.2:1, "Type IV Sheeting - Unmetallized Microprismatic Element," and Table 701.2.4.1.2:2, "Type VIII F Sheeting - Fluorescent Microprismatic Lens."

702.2.2.3 Traffic Markers

The Contractor shall provide traffic marker Materials in accordance with Section 703, "Traffic Markers."

702.2.2.4 Drums

The Contractor shall provide non-metal drums in accordance with the *MUTCD, current edition* and as approved by the Project Manager. The Contractor shall use only one (1) size drum on the Project.

The Contractor shall use reflectorized drums with fluorescent orange and white high-performance retroreflective sheeting or recording. The Contractor shall use horizontal, circumferential, fluorescent orange and white reflectorized stripes from four (4) inches to six (6) inches wide for drum marking. The Contractor shall ensure the number of alternating fluorescent orange and white reflectorized stripes and the amount of non-reflective drum surface space is in accordance with the *MUTCD, current edition*.

The Contractor shall provide drums that are a minimum 36 inches high and 18 inches diameter with a closed top, and either a sand-ballasted, preformed rubberized, or tire sidewall-collared base, in accordance with the manufacturer's recommendations.

702.2.2.4.1 Warning Lights

The Contractor shall provide either Type "A" low intensity, Type "B" high intensity, or Type "C" steady-burn warning lights in accordance with the *MUTCD, current edition*.

702.2.2.4.2 Flexible High-Performance Reflective Sheeting

The Contractor shall provide retroreflective sheeting and adhesive Materials in accordance with Section 701, "Traffic Signs and Sign Structures," except provide Type VIII or greater intensity retroreflective sheeting.

The Contractor shall provide sheeting with a pre-coated adhesive protected by a removable liner. The Contractor shall apply to channelization devices in accordance with manufacturer's recommendations.

702.2.2.4.2.1 Sheeting Flexibility

The Contractor shall use sheeting that does not exhibit cracking when bent around a 1/8 inch mandrel in one (1) second, after conditioning for 24 h at 32 °F with the liner removed. The Contractor shall test by spreading talcum powder on adhesive and bending with the adhesive side contacting the mandrel.

702.2.2.4.2.2 Adhesive

The Contractor shall provide pressure sensitive adhesives for use on substrates, other than plasticized PVC, in accordance with Section 701.2.4.1, "Retroreflective Sheeting."

702.2.2.4.2.3 Adhesive Backing Testing

The Contractor shall test pressure sensitive adhesive backing on flexible high performance sheeting in accordance with FHWA Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP-96), Section 718. Backing adhesive must support a 1 3/4 lb weight for five (5) min without peeling away more than one (1) inch if applied to a smooth aluminum surface.

702.2.2.4.2.4 Reflectivity

The Contractor shall provide flexible high-performance sheeting that meets or exceeds the minimum reflectivity requirements in Table 701.2.4.1.2:1, "Type IV Sheeting – Unmetallized Microprismatic Element," and Table 701.2.4.1.2:2, "Type VIII F Sheeting - Fluorescent Microprismatic Lens."

702.2.2.5 Traffic Cones

The Contractor shall provide traffic cones in accordance with the MUTCD, current edition and having a flexible cone (above the base) with an outer section made of a highly pigmented fluorescent orange polyvinyl compound.

The Contractor shall provide cones at least 28 inches tall weighing at least ten (10) lb with a base alone weighing seven (7) lb, with a distribution of cone weight effectively holding the traffic cones upright under traffic conditions.

If approved by the Project Manager, the Contractor shall use tubular traffic markers manufactured, installed, and maintained in accordance with Section 703, "Traffic Markers," instead of traffic cones.

702.2.3 Sequential Arrow Displays

The Contractor shall use a sequential arrow display consisting of a sign panel assembly and a power source. The Contractor shall mount the display on a two (2)-wheeled trailer or on a vehicle for mobile operations. The Contractor shall provide a sequential arrow display in accordance with the *MUTCD, current edition* Specifications for arrow displays. The Contractor shall use Type B panels for mobile operations and Type C panels for stationary traffic control. The Contractor shall provide a trailer in accordance with Section 702.2.4.5, "Trailer." The Contractor shall provide a display powered by diesel or solar power or one that connects to an external power supply. The Contractor shall ensure electrical connections meet or exceed the

applicable electrical code requirements. The Contractor shall provide solar-powered systems with a battery-backup power supply capable of maintaining operation for a minimum of 12 consecutive 24-hour Days.

702.2.3.1 Operating Modes

The Contractor shall ensure that displays are capable of the following operating modes (see the *MUTCD, current edition* Specifications for advance warning arrow display):

1. Pass Left - Three (3) chevrons of five (5) lamps each sequencing right-to-left;
2. Pass Right - Three (3) chevrons of five (5) lamps each sequencing left-to-right;
3. Pass Either Side - Two (2) outermost chevrons on each end of the panel pointing outward forming arrowheads with crossing lamp rows burning continuously. Do not burn the first lamp directly behind the point of each arrow, to define the arrow points; and
4. Caution - Four (4) lamps, one (1) at each corner of the panel.

702.2.4 Portable Changeable Message Signs

Portable changeable message signs will consist of a sign panel assembly, controller, power supply, and structural support system mounted on a two (2)-wheeled trailer. The Contractor shall supply new portable changeable message signs if the Contract specifies that the Department will retain the message signs upon Final Acceptance.

702.2.4.1 Sign Panel Assembly

The Contractor shall provide a sign panel consisting of a three (3)-line panel assembly. The Contractor shall ensure that each line contains eight (8) matrices capable of producing at least eight (8) individually changeable characters. The Contractor shall ensure that each character module uses, as a minimum, a five (5)-wide pixel by seven (7)-high pixel matrix, with each matrix measuring at least 18 inches high and nine (9) inches wide.

The Contractor shall ensure a clearly displayed message on the sign panel that is legible from a distance of 800 ft during daytime and nighttime operation at angles in accordance with the *MUTCD, current edition* Specifications for portable changeable message signs.

702.2.4.2 Controller

The Contractor shall provide a compact controller located to allow easy access to sign and message functions from a control cabinet on the trailer.

The Contractor shall provide a solid-state unit controller capable of generating and storing sign messages.

The Contractor shall provide a controller keyboard that allows the user to recall and use messages from permanent memory storage containing a library of standard messages. The controller will also have the capacity to store, recall, and use at least 50 additional messages generated by the operator.

The Contractor shall use a controller with a protective device that requires an entry code to access the memory and display messages to prevent unauthorized programming.

702.2.4.3 Power Supply

The Contractor shall provide a power unit capable of powering the message sign continuously for at least 21 consecutive 24-hour Days, with a fail-safe backup power supply system, and capable of being powered directly by a 120 V AC external power supply.

702.2.4.4 Structural Support Systems

The Contractor shall provide a structural support system with a mechanism capable of raising and lowering the sign panel at sustained wind speeds of 55 mph, and capable of operation by one (1) person without use of heavy Equipment. The Contractor shall ensure a clearance of at least seven (7) ft between the sign panel bottom and the pavement surface, when fully raised.

702.2.4.5 Trailer

The Contractor shall use a two (2) -wheel single-axle system trailer with a suspension rated at no less than 2,000 lb.

The Contractor shall provide a trailer equipped with the following:

1. Four (4) non-removable leveling jacks, one (1) at each corner of the trailer,
2. A tongue and either a towing eye, for use with the pintle hook, or a ball receptacle, for a ball-type trailer hitch. Fabricate a 2 1/2 inches inside diameter towing eye from one (1) inch round, solid steel. Size the ball receptacle to accept a standard two (2) inch ball;
3. Two (2) safety chains with 1/4 inch diameter links. Install one (1) chain on each side of the draw bar and extend 24 inches beyond the towing eye. Install a safety hook on the outer end of each chain;
4. Two (2) combination tail, turn, and stop lights;
5. A license plate bracket and illumination lamp;
6. A standard SAE seven (7)-way trailer light wire connector on a cable extending 24 inches beyond the towing eye; and
7. A means of securing a receptacle on the trailer tongue.

702.2.5 Temporary Signal Span

The Contractor shall provide poles and associated electrical items for temporary signal spans in accordance with Section 715, "Beacons and Temporary Signal Equipment."

702.3 CONSTRUCTION REQUIREMENTS

702.3.1 General

The Contractor shall provide construction traffic control devices in accordance with *MUTCD, current edition* and *NCHRP Report 350*. Construction traffic control devices shall remain the property of the Contractor, unless otherwise specified in the Contract.

The Contractor shall install signs, steel posts, and base posts in accordance with the requirements of Section 701, "Traffic Signs and Sign Structures." The Contractor shall provide drums equipped with Type "C" steady-burn warning lights on channelization recordings, if in night operation.

The Contractor shall install traffic markers in accordance with the requirements of Section 703, "Traffic Markers."

The Contractor shall use Type A or Type B flashing warning lights and flags to call attention to advance warning construction signing.

The Contractor shall use Traffic Cones only during daylight hours.

The Contractor shall completely cover all conflicting signs within or in advance of the Work zone with an opaque non-light transmitting Material so as not to damage the sign. Failure to adhere to this requirement will result in the Contractor replacing the sign at no cost to the Department.

702.3.1.1 Portable Sign Support System

Portable sign stands for rigid signs must be capable of accommodating rigid signs, 30 in. X 30 in. to 48 in. X 48 in. Unit must be transportable as a secure unit. Base shall be adequate to support the stand and signs without bending and to be light weight. Retaining brackets shall be provided to adequately secure the sign to the portable sign support.

702.3.1.2 Temporary Signal Spans

The Contractor shall use temporary signal spans consisting of poles and associated electrical items in accordance with Section 715, "Beacons and Temporary Signal Equipment."

The Contractor shall remove temporary signal spans after Project Detours are removed, or as directed by the Project Manager.

702.3.2 Maintenance

The Contractor shall maintain the traffic control plan and devices in accordance with Section 618, "Traffic Control Management."

The Contractor shall keep construction traffic control devices clean so that the intended visibility is not diminished. The condition of construction traffic control devices is subject to Department approval.

702.4 METHOD OF MEASUREMENT—Reserved

702.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Construction Signing</i>	Square Foot
<i>Steel Posts and Base Posts for Construction Signing</i>	Linear Foot
<i>Barricade, Type_____</i>	Each
<i>Vertical Panel, Type_____</i>	Each
<i>Construction Traffic Marker</i>	Each
<i>Portable Sign Support</i>	Each
<i>Channelization Device, Type_____</i>	Each
<i>Sequential Arrow Display</i>	Each
<i>Portable Changeable Message Sign</i>	Each
<i>Traffic Cone</i>	Each
<i>Temporary Signal Span</i>	Lump Sum

702.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Supports required for vertical panels and poles, and all associated electrical and mechanical items for temporary signal span;
2. Moving of construction traffic control devices from one (1) location to another, maintenance, and repair or replacement of damaged or destroyed traffic control devices;
3. Additional traffic control device quantities approved and implemented solely for the Contractor's convenience;
4. Type "A" low-intensity warning lights, Type "B" high-intensity warning lights, or Type "C" steady-burn warning lights and signing which are attached to barricades, drums and construction signs;
5. Removal of signs and devices as well as all other items associated with and required for installation or function of devices used for construction traffic control devices;
6. Covering all conflicting signs within or in advance of the Work zone with an opaque non-light transmitting Material; and
7. In the event of a Compensable Delay, the devices owned by the Contractor are not eligible for additional compensation. Devices leased by the Contractor may be eligible for additional compensation based on actual costs incurred.

SECTION 703: TRAFFIC MARKERS

703.1 DESCRIPTION

This Work consists of providing and installing traffic markers and appurtenances in accordance with the MUTCD, current edition and NCHRP Report 350 and/or MASH, as specified in the Contract, or as directed by the Project Manager.

703.2 MATERIALS

703.2.1 Object Markers, Delineator Posts, Tenth-Mile Delineators

The Contractor shall provide posts of shape, dimensions, and tolerances in accordance with the Contract and the Department's *Approved Products List*.

The Contractor shall punch posts with 3/8 inch diameter holes and, unless otherwise specified; ensure a total length of seven (7) ft \pm 1/2 inch.

703.2.1.1 Steel Posts

The Contractor shall provide steel posts that:

1. Are rolled from rail or billet steel in accordance with ASTM A 499;
2. Are galvanized in accordance with ASTM A 123, with the Pivoted Hammer Test waived, or painted with a black modified polyester paint meeting the requirements of Federal Standard 595a (Color No. 17038), applied by electro-deposition to a minimum one (1) mil thickness;
3. Have a smooth, uniform finish free from defects effecting strength or appearance, whether galvanized or painted; and
4. Have a minimum weight of at least 1.07 lb per foot.

The Contractor shall obtain Department approval of alternate paint colors or application before fabrication.

703.2.1.2 Hardware

The Contractor shall provide hardware that is galvanized or cadmium-plated in accordance with ASTM B 766-86, current version; or mechanically galvanized in accordance with AASHTO M 298, Class 25; or stainless steel.

703.2.2 Reflector Unit

For the reflector unit for object markers and Road delineators, the Contractor shall provide a methyl methacrylate (acrylic) prismatic reflector with a rustproof or plastic housing of a minimum 0.02 inch thickness with a center mounting hole. The Contractor shall expand a metal or plastic grommet with a 3/16 inch inside diameter within the reflector-mounting hole.

The Contractor shall provide reflector units in accordance with Table 703.2.2:1, "Specific Intensity Values — Round Reflectors," or Table 703.2.2:2, "Specific Intensity Values — Rectangular Reflectors," as applicable.

The Contractor shall provide round reflectors with at least a three (3) inch diameter and rectangular reflective panels at least six (6) inches \times 12 inches.

**Table 703.2.2:1
Specific Intensity Values — Round Reflectors**

OA	EA	Minimum reflective intensity (candlepower per foot-candle)	
		Crystal	Amber
0.1	0.0	119.0	71
0.1	20.0	47.0	28
0.33	0.0	26.0	16
0.33	20.0	13.0	8

**Table 703.2.2:2
Specific Intensity Values — Rectangular Reflectors**

OA	EA	Minimum reflective intensity (candlepower per foot-candle)		
		Crystal	Amber	Red
0.2	20 ^a	40.0	30.0	10.0
0.2	10 ^a	105.0	75.0	27.0
0.2	0	125.0	90.0	35.0
0.2	5 ^b	125.0	90.0	30.0
0.2	10 ^b	105.0	75.0	30.0
0.2	20 ^b	85.0	60.0	25.0
0.2	30 ^b	30.0	30.0	7.0
0.2	40 ^b	15.0	15.0	4.0

^aIndicates off traffic side.

^bIndicates traffic side.

703.2.3 Flexible Traffic Markers

The Contractor shall provide flexible traffic markers that consist of a nonmetallic post with reflective sheeting and a drivable or non-drivable anchor system, as applicable.

The Contractor shall provide posts for flexible traffic markers fabricated from a flexible, nonmetallic Material, resistant to impact, ultraviolet light, ozone, and hydrocarbon damage, and stiffening with age. The Contractor shall provide well-manufactured posts free from burrs, discoloration, contamination, and other objectionable marks or defects.

The Contractor shall use white, yellow, brown, or orange for flexible traffic markers, as specified in the Contract. The Contractor shall provide flexible traffic marker posts that are flexible throughout the temperature range of from -38 °F to 150 °F, and provide an installed height of from 18 inches to 48 inches.

The Contractor shall use self-restoring flexible traffic markers remaining serviceable after being subjected to a series of direct impacts by a standard vehicle. The Contractor shall ensure posts and delineators are capable of withstanding five (5) impacts at any angle at a speed of 55 mph and ten (10) impacts at any angle at a speed of 35 mph.

The Contractor shall provide posts designed for a permanent installation to resist overturning, twisting, and displacement from wind and impact forces.

703.2.3.1 Tubular Flexible Traffic Markers

The Contractor shall provide tubular traffic marker posts and bases of a thermoplastic or pliable elastomer composition meeting the manufacturer's requirements, with dimensions in accordance with Table 703.2.3.1:1, "Dimension Requirements for Tubular Traffic Markers."

The Contractor shall provide tubular traffic marker bases painted black, or the same color as the post.

The Contractor shall provide assembly units necessary for the particular marker in accordance with the manufacturer's recommendations.

Table 703.2.3.1:1
Dimension Requirements for Tubular Traffic Markers

Description	Dimensions (inch)
Outside diameter	2.23-4
Wall thickness, minimum	1/8

703.2.3.2 Flexible Traffic Marker Anchor Systems

The Contractor shall provide preformed steel anchors for drivable reusable anchor systems. If providing tubular anchors, the Contractor shall ensure closed bottoms, to prevent soil entrance during driving.

The Contractor shall use non-drivable, pre-drilled systems for direct burial of the post into soil. The Contractor may retain posts with "O" clips (self-locking) for posts in holes 18 inches deep. The Department may Accept other direct burial methods after local demonstration of their stability.

The Contractor shall provide surface mounted bases with a height of from 1/2 inch to two (2) inch and an outside diameter of from seven (7) inch to 12 inch.

The Contractor shall provide drive-down bases with the dimensions listed on the Department's *Approved Products List*.

703.2.3.3 Adhesives for Flexible Traffic Markers

The Contractor shall provide epoxy type (permanent installation) or butyl type (temporary installation) adhesives in accordance with the manufacturer's recommendations.

The Contractor may use other methods, as approved by the Project Manager before the Work begins.

703.2.3.4 Flexible Traffic Marker Retroreflective Sheeting

The Contractor shall provide flexible traffic markers with two (2) three (3) inches high pre-applied retroreflective sheeting bands. The Contractor shall begin the bands no more than two (2) inches from the top, with no more than six (6) inches between them in the front and back, or around the entire circumference.

The Contractor shall provide pre-applied retroreflective sheeting in accordance with Section 702.2.2, "Barricades and Channelization Devices," and Table 701.2.4.1.2:1, "Type IV Sheeting – Unmetallized Microprismatic Element," and Table 701.2.4.1.2:2, "Type VIII F Sheeting – Fluorescent Microprismatic Lens," of a color in accordance with the Contract.

703.2.4 Reflective Barrier Delineator

The Contractor shall provide a reflective barrier delineator that consists of an acrylic-plastic shell assembled on a flat plastic base to form a hermetically sealed unit. The Contractor shall ensure that the sloped face contains one (1) prismatic reflective surface to reflect incident light from a single direction.

The Contractor shall provide methyl methacrylate acrylic plastic shells and flat plastic bases in accordance with Federal Specification LP-390C, Type I, Class 3.

703.2.4.1 Reflective Barrier Delineator Adhesive

The Contractor shall provide adhesive capable of fixing delineators for the duration of their intended use. The Contractor shall use primer, as specified by the manufacturer, to prepare the pre-cleaned barrier surface.

703.2.4.2 Reflective Barrier Delineator Configuration

The Contractor shall provide the reflective barrier delineator in accordance with the Contract and Table 703.2.4.2:1, "Requirements for Reflective Barrier Delineator Configuration."

**Table 703.2.4.2:1
Requirements for Reflective Barrier Delineator Configuration**

Description	Requirement
Slope of reflecting face (degrees)	0-11
Area of reflecting face, minimum (square inches)	6 1/2

The Contractor shall ensure that the outer shell surface is smooth except for identification markings. The Contractor shall provide a nontransparent (white or light gray) base of the marker with an attached 0.12 inch thick pad of pressure sensitive adhesive and a minimum overall height of 2.46 inches including the adhesive pad.

703.2.4.3 Reflective Barrier Delineator Optical Requirements

When the reflective barrier delineator is mounted with its base flat against a vertical surface with the leading edge of the delineator perpendicular to the horizontal plane, the Contractor shall ensure the Specific Intensity in accordance with Table 703.2.4.3:1, "Specific Intensity Values Reflective Barrier Delineator." The Contractor shall ensure the Specific Intensity for yellow delineators of at least 60% of the value for crystal reflecting surface.

**Table 703.2.4.3:1
Specific Intensity Values Reflective Barrier Delineator**

Minimum reflective intensity (candlepower per foot-candle)		
OA	EA	Crystal
0.1	0	55.0

703.2.5 Sign Post Reflector Panel

The Contractor shall provide sign post reflector panel(s) of shape, dimension, color and tolerances specified in the Contract. Panels shall also be in conformance with the MUTCD (current edition).

Sign post reflector panels shall be constructed of a UV-stabilized high-impact thermoplastic alloy.

All retroreflective sheeting shall conform to Section 701.2.4.1, "Retroreflective Sheeting" and shall be factory-applied by the manufacturer.

703.3 CONSTRUCTION REQUIREMENTS

The Contractor shall set posts plumb and to the depth specified in the Contract. Posts may be driven. The Project Manager will direct placement of posts set in rock.

The Contractor shall provide object markers and Road delineators in accordance with the MUTCD, current edition. The Contractor shall label object markers as A3, OM-1, OM-2H, or OM-3.

If removal of an installation (temporary or permanent) is necessary and the metal, concrete, or asphalt surface is damaged, the Contractor shall repair and otherwise restore the damaged surface to its original condition, at no additional cost to the Department. The Contractor shall replace defective posts, bases, assembly units, adhesives, or reflective sheeting that interfere with the intended use of the traffic markers, at no additional cost to the Department.

703.3.1 Surface-Mounted Flexible Traffic Marker Installations

The Contractor shall thoroughly clean metal, concrete, or asphalt surfaces before mounting flexible traffic markers. The Contractor shall sandblast or wire-brush metal and concrete surfaces. The Contractor shall clean asphalt surfaces in accordance with the adhesive manufacturer's recommendations. The Contractor shall remove loose sand, dust, and other Deleterious Material from cleaned mounting surfaces.

The Contractor shall apply adhesive and install surface mounted flexible traffic markers in accordance with the manufacturer's recommendations.

703.3.2 Reflective Barrier Delineators Installation

The Contractor shall install reflective barrier delineators in accordance with the manufacturer's recommendations, using a pressure-sensitive system on a clean, dry, vertical surface at intervals and the distance above the road surface, as specified in the Contract, or as directed by the Project Manager.

703.3.3 Sign Post Reflector Panel Installation

Sign post reflector panels shall be bolted to the post with anti-theft hardware in accordance with the manufacturer's recommendations and as approved by the Project Manager.

703.4 METHOD OF MEASUREMENT—Reserved

703.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Object Marker Type</i> _____	Each
<i>Road Delineator Type</i> _____	Each
<i>Flexible Traffic Marker</i>	Each

<i>Tubular Flexible Traffic Marker</i>	Each
<i>Reflective Barrier Delineator</i>	Each
<i>1/10-Mile Delineator</i>	Each
<i>Sign Post Reflector Panel</i>	Each

703.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Adhesive;
2. Anchors;
3. Retroreflective sheeting;
4. Reflector units;
5. Hardware; and
6. Excavation, backfill, and compaction for marker installations.

SECTION 704: PAVEMENT MARKINGS

704.1 DESCRIPTION

This Work consists of providing Materials, labor, and Equipment for placement of retroreflectorized painted markings high durable (HD) 100 % acrylic waterborne traffic paint in accordance with these Specifications, the manufacturer's Specifications, the current edition of the MUTCD, and in compliance with the lines, grades, dimensions, and details shown in the Contract.

704.2 MATERIALS

1. Traffic paint shall conform to the requirements of the Department's latest Specifications for Traffic paint, Designation M-TPC-WBACRHB. Copies of this Specification are available from Traffic Services Engineer.
2. Reflectorized glass beads shall conform to the requirements of the Department's latest specifications for glass beads, Designation MGRB, Type DAB. Copies of this Specification are available from Traffic Services Engineer.

704.2.1 Material Sampling, Testing, and Acceptance of Materials

The Contractor shall provide Certificates of Compliance and documentation that the State Materials Bureau has tested the batch of paint. At the discretion of the Project Manager, the Department may take random samples of the traffic paint for testing. The Department will reject traffic paint used before submitting the proper documentation, if the test results do not meet the Specifications.

The Contractor shall submit to the State Materials Bureau samples of traffic paint and glass beads as per NMDOT Traffic Paint Sampling and Testing Procedures. The State Materials Bureau will test samples for compliance and issue a report as designated in current Departments Specifications for Traffic Paint and Glass Beads. The Department reserves the right to have an inspector present to observe the sampling or manufacturing process. Copies of traffic paint sampling procedures are available from Traffic Services Engineer or State Materials Bureau.

The Contractor shall furnish each Project a certificate with reference to the State Materials Bureau test control number, indicating that Materials provided to the Project have been tested and accepted by the State Materials Bureau, verifications of the certification will be made by Project personnel checking the batch or lot number on the traffic paint or glass beads furnished to the Project.

704.3 CONSTRUCTION REQUIREMENTS

704.3.1 General Standard Procedures

The Contractor shall place the traffic paint and beads on the roadway surface using a pavement marking machine. Application shall be during daylight hours and when the pavement surface is dry and the weather is not foggy, rainy, excessively windy, or otherwise detrimental to the application of markings. The Contractor shall remove excess asphalt or other deleterious substances, dirt, debris, grease, motor oils, rocks, or chips from the pavement surface prior to applying markings. Pavement markings must be installed as per manufacturer's recommendation or as directed by Project Manager, this includes the use of cold weather additives.

The Contractor shall provide the necessary personnel and Equipment to divert traffic from the installation area while the Work is in progress and during the no track or drying time of the Pavement Marking Material.

704.3.2 Equipment for Painted Markings

The machine shall be self-propelled spray type and equipped with an arrow board and warning lights sufficient to aid in traffic control. The Department will allow placing temporary striping during construction with other Equipment designed for application of paint and glass beads as approved by the Project Manager.

1. The Contractor shall use a machine capable of applying clearly defined markings within the designated width as specified on Section 704.3.6, "Dimension Tolerances" on Project Plans or Standard Drawings.
2. The machine must be equipped with a device capable of producing various lengths of painted segments and gaps that do not vary more than six (6) inches for a 40 ft cycle.
3. The machine shall be equipped with air-operated paint and glass bead dispensers capable of producing markings as per 704.1.3.5, "Rates and Tolerances for Painted Markings."

704.3.3 Striping Operations Traffic Control Requirements

The Contractor shall submit a traffic control plan in accordance with the MUTCD, current edition, to the Project Manager for approval prior to placing markings unless the Contract already provides an approved Plan.

704.3.4 Number of Applications and Retroreflectivity

Permanent reflectorized painted markings consist of two (2) applications, unless otherwise specified in the Contract. The second application shall not be placed sooner than ten (10) Days after the first application. Subsequent applications, as called for in the Contract, shall not be placed sooner than one (1) Day after the previous application.

The Project Manager will, at their discretion, measure the retroreflectivity of the markings using 30-M geometry in units of mcd/m²/lux. The markings will be measured within twenty-one (21) days of the final application. The measurements will be taken every ¼ mile per line and an average will be calculated for every-mile per line. See Table 704.3.4:1, "Minimum Reflective Values for Painted Markings for Tolerances."

**Table 704.3.4:1
Minimum Reflective Values for Painted Markings for Tolerances**

White Painted Markings (mcd/m ² /lux)	Yellow Painted Markings (mcd/m ² /lux)
250	150

704.3.5 Rates and Tolerances for Painted Markings

For Permanent markings, apply paint at a rate of 22 to 25 wet mills, (25.15 gal per mile of paint for a solid four (4) inch line 6.31 gal per mile for a broken four (4) inch line). The Contractor shall apply other widths of striping at appropriate multiples of these minimum rates for solid and broken paint stripes.

For Temporary markings, the Contractor shall apply paint at a rate of 15 wet mills (16.5 gal per mile of four (4) inch solid and 4.13 gallons per mile for broken four (4) inch line.)

Glass beads shall be applied at a minimum rate of six (6) lb to each gallon of paint for both permanent and temporary markings.

Measurement of the volume of paint and beads in the tanks per one (1) of the following measurement methods:

1. Strap measurement; a calibrated rod marked with the equivalent volumes. Provide certification for the volumes of the paint and bead tanks;
2. Calibrated, readable external tank marks indicating a volume equivalent for the tank; or
3. Electronic device (Data Logging System) capable of recording and reporting Material usage and application rates.

704.3.6 Dimension Tolerances

Transverse gap dimensions between centerline stripes for two (2) and combinations using a three (3) paint gun set up on striping machine:

1. Place the broken line on the centerline of the Roadway with the respective left and right no passing zone stripes placed with a two (2) inch gap between the broken and solid no passing zone stripes;
2. Eight (8) inch gap between standard double yellow markings, and two (2) inch gap for narrow double yellow;
3. Tolerance of four (4), six (6), eight (8), 12 and 24 inch lines shown on plans shall be plus or minus 1/8 inch. Legends and symbols shall be in accordance with the applicable shapes and sizes in the MUTCD, current edition;
4. Standard skip pattern is ten (10) foot stripe and thirty (30) foot gap (40-foot cycle) plus or minus six (6) inches per cycle, other cycles as per Departments Standard Drawings;
5. The pavement markings shall be placed in proper alignment with guidelines established on the Roadway, deviation from the alignment established shall not exceed two (2) inches per 200 feet of Roadway nor shall any deviation be abrupt; and
6. Markings shall be offset at least two (2) inches from longitudinal construction joints.

704.3.7 Repair and Replacement of Unacceptable or Damaged Striping

The Contractor shall remove, replace or repair the striping if:

1. Paint does not adhere to the pavement;
2. Glass beads do not adhere to the paint or if reflectivity is less than 50%; or
3. The second application of pavement markings is not placed over the first application of markings in accordance with Section 704.1.3.5, "Rates and Tolerances."

The Contractor shall repair damage to pavement markings due to negligence or failure to maintain traffic control at no additional cost to the Department.

704.4 METHOD OF MEASUREMENT

No payment will be made for the number of skips (spaces) in long line pavement marking

applications.

The Department will measure permanent and temporary Retroreflectorized Painted Markings for four (4) inch, six (6) inch, eight (8) inch, 12 inch, and 24 inch widths using multiples of the standard four (4) inch width to calculate a total length. Legends, symbols and specialty markings will be paid by each.

The Department will measure each application for payment.

**Table 704.4:1
Permanent Painted Markings Volume Control**

Measured Rate of Application Paint-Gallons/Mile		Reduction
27.43 to 24.14		0%
24.13 to 20.85		10%
20.84 to 17.75		25%
<17.75		50%
Measured Rate of Application Glass Beads	Pounds/Gal.	Reduction
	6.0 – 5.0	0%
	4.9 – 4.0	17%
	3.9 – 3.0	33%
	<3.0	50%

704.5 BASIS OF PAYMENT

Pay Item Pay	Unit
<i>Reflectorized Painted Markings</i> ____ <i>inch</i>	Foot
<i>Temporary Reflectorized Painted Markings</i> ____ <i> inch</i>	Foot
<i>Reflectorized Painted Arrow, type</i> ____	Each
<i>Reflectorized Painted Word (____)</i>	Each
<i>Reflectorized Painted Symbol, type</i> ____	Each
<i>Retroreflectorized Painted Railroad Crossing</i>	Each

704.5.1 Payments

The Department will not pay for striping until the Project Manager receives the required certification and documentation. If the Project Manager determines that the *volumes* of paint and glass beads were not installed as per Departments Specifications, the Department will reduce payment in accordance with Table 704.4.1, "Permanent Painted Markings Volume Control."

At their discretion, the Project Manager will observe the striping at night to determine whether the striping is Acceptable or if re-striping is necessary. If striping is not Acceptable, it shall be restriped at no additional cost to the Department.

704.5.2 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Removal of temporary marking tape;
2. Repair or replacement of damaged striping due to Contractor's negligence or

- operations;
3. Standard surface preparation;
 4. Maintaining and protecting the pavement markings from traffic during the marking operations;
 5. Mobile traffic control operations for long line traffic marking operations;
 6. Black out line for contrast markings; and
 7. Cold weather additives.

704-A: TEMPORARY MARKING TAPE

704-A.1 DESCRIPTION

This work consists of providing Materials, labor, and Equipment for placement of Temporary and Temporary removable marking tapes in substantial compliance with these Specifications and the current edition of the MUTCD, as shown in the Contract or as directed by the Project Manager.

704-A.2 MATERIALS

The Contractor shall provide weather resistant Material that shows no measurable fading, lifting, or shrinkage, and is free of cracks, with true, straight, and unbroken edges.

Material shall be reflective yellow or white on a conformable backing coated with a pressure-sensitive adhesive and designed for marking asphalt or PCC surfaces that meets or exceeds the minimum retroreflectivity values in Table 704-A.2:1, "Temporary Marking Tape Retroreflectivity," as measured in accordance with the testing procedure of Federal Test Method Standard 370, unless a higher value is specified.

**Table 704-A.2:1
Temporary Marking Tape Retroreflectivity**

OA	EA	White	Yellow
0.2	86	1,770	1,310
0.05	86	1,270	820

The Department will designate temporary marking tape as removable or non-removable in accordance with Section 704-A.2.1, "Temporary Removable Marking Tape," and Section 704-A.2.4, "Temporary Non-Removable Marking Tape Dimensions."

The Contractor shall match the visible or outer surface color to the paint color in Section 704.2, "Materials."

704-A.2.1 Temporary Removable Marking Tape

704-A.2.2 Temporary Removable Marking Tape Dimensions

For normal use, the Contractor shall provide removable temporary marking tape that is at least 35 mil thick and four (4) inches or six (6) inches wide, or as indicated in the Plans.

704-A.2.3 Temporary Removable Marking Tape Removability

The Contractor shall provide removable marking tape that is readily removable from the pavement with the manufacturer's recommendations without sandblasting, solvent, burning, or diamond grinding methods, unless otherwise specified.

704-A.2.4 Temporary Non-Removable Marking Tape Dimensions

The Contractor shall provide non-removable temporary marking tape that is at least ten (10) mils thick and four (4) inches or six (6) inches wide, or as indicated in the Plans.

704-A.3 CONSTRUCTION REQUIREMENTS

704-A.3.1 Surface Preparation

The Contractor shall ensure that the pavement surface is free of moisture, soil, or other deleterious substances by sweeping clean or using compressed air.

704-A.3.2 Placing Temporary Marking Tape

The Department will allow only removable marking tape for temporary marking of final pavement surfaces, unless otherwise specified in the Contract.

The Contractor shall provide the necessary personnel and Equipment to warn and divert traffic during installation and removal of temporary marking tape from the area where work is in progress.

Temporary tape installation shall follow manufacturer's recommendations. The Contractor shall apply a primer to Roadway surface if recommended by the temporary tape manufacturer, roll or tamp until temporary tape adheres properly and conforms to the surface of the pavement. Where striping is continuous, the Contractor shall not place more than three (3) splices per 120 ft of length.

704-A.4 METHOD OF MEASUREMENT

The Department will measure Temporary Removable and Non-removable Marking Tape by four (4) inch, six (6) inch, eight (8) inch, 12 inch, and 24 inch widths using inch width to calculate a total length.

704-A.5 BASIS OF PAYMENT

Pay Item Pay	Unit
<i>Removable Marking Tape_____inch</i>	Foot

704-A.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Repair or replacement of damaged striping due to Contractor's negligence or operations;
2. Furnishing, mixing, and applying adhesive or primers;
3. Standard surface preparation;
4. Mobile traffic control operations for traffic marking operations;
5. Removal of "Removable Marking Tape;"
6. Black out line for contrast markings; and
7. Repair or replacement of damaged striping.

704-B: RETROREFLECTIVE PREFORMED PLASTIC MARKINGS (TAPE)

704-B.1 DESCRIPTION

This work consists of providing Materials, labor, and Equipment for placement of Retroreflective Preformed Plastic Marking Material in substantial compliance with these Specifications and the current edition of the MUTCD, as shown in the Contract or as directed by the Project Manager.

Materials shall be made of white, or yellow weather resistant retroreflective film, with adhesive system recommended by the manufacture for installation. For contrast markings black weather resistant plastic film is non-reflective.

The Contractor shall provide prefabricated legends and symbols in accordance with the applicable shapes and sizes in the MUTCD, current edition.

704-B.2 MATERIALS

The Contractor shall provide retroreflective preformed plastic markings that consist of high quality plastic Materials, pigments, with a retroreflective layer of beads or reflective ceramics embedded in the top surface.

The Contractor shall:

1. Ensure that the surface of the tape marking Material provides a minimum skid resistance value of 35 British Pendulum Number when tested in accordance with ASTM E 303;
2. Provide tape Material, including symbols and legends, which is at least 60 mils thick for surface or inlaid installations. Legends and symbols shall be in accordance with the applicable shapes and sizes in the MUTCD, current edition;
3. Ensure that the tape Materials provide a neat, durable marking when properly applied and that the tape Materials provide a cushioned resilient substrate that reduces bead crushing and loss;
4. Ensure that preformed plastic pavement marking color shall conform to the requirements of ASTM D 6628; and
5. Provide film that (through normal traffic wear) is weather resistant, shows no measurable fading, lifting, or shrinkage throughout the life of the marking, and shows no significant tearing, rollback, or other signs of poor adhesion. Provide tape Material capable of conforming to pavement contours, breaks, faults, etc., under traffic.

704-B.2.1 Retroreflective Preformed Plastic Pavement Markings (Tape)

The Contractor shall utilize Type II Retroreflective Preformed Plastic Pavement Markings (Permanent, Extended durability, High retroreflectivity tape), Retroreflectivity level II in accordance to ASTM D 4505.

704-B.2.2 Acceptance of Materials for Retroreflective Preformed Plastic Pavement Markings (Tape)

The Contractor shall supply a letter of certification from the manufacturer with each batch certifying the Material meets the requirements of the Departments current Specifications and, this section.

704-B.3 CONSTRUCTION REQUIREMENTS

704-B.3.1 Placing Retroreflective Preformed Plastic Markings (Tape)

The Contractor shall apply stripes, legends and symbols to the pavement as specified and in accordance to manufactures recommendations, or as directed by the Project Manager.

The Contractor shall provide the necessary personnel and Equipment to warn and divert traffic during installation and removal of temporary marking tape from the area where the Work is in progress.

Roadway surface temperature range of 50 °F - 115 °F, install primer if recommended, roll or tamp the tape until it adheres properly and conforms to the surface of the Roadway surface. Where striping is continuous, the Contractor shall not place more than three (3) splices per 120 ft of length. Application at a lower temperature may be permitted as approved by the Project Manager.

Inlay of markings should be taken into consideration in snow plow areas or areas where aggressive traffic shear is a concern. If inlay of markings is required, payment for inlay shall be paid for separately as specified in the Contract.

For placement of inlayed markings on new asphalt pavement, apply tape markings to the pavement before final rolling is completed or as per manufacturer's recommendations.

704-B.4 METHOD OF MEASUREMENT

The Department will measure Retroreflective Preformed Plastic Pavement Markings (Tape) by four (4) inch, six (6) inch, eight (8) inch, 12 inch, and 24 inch widths using inch width to calculate a total length. Legends, symbols and specialty markings will be paid by each.

704-B.5 BASIS OF PAYMENT

Pay Item Pay	Unit
<i>Retroreflective Preformed Plastic Marking (Tape) ____ inch</i>	Foot
<i>Retroreflective Preformed Plastic Marking (Tape) Arrow, ____</i>	Each
<i>Retroreflective Preformed Plastic Marking (Tape) Word, ____</i>	Each
<i>Retroreflective Preformed Plastic Marking (Tape) Symbol ____</i>	Each
<i>Retroreflective Preformed Plastic Marking (Tape) Railroad Crossing ____</i>	Each

704-B.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Repair or replacement of damaged striping due to Contractor's negligence or operations;
2. Furnishing, mixing, and applying adhesive or primers;
3. Standard surface preparation;
4. Mobile traffic control operations for traffic marking operations; and
5. Black out line for contrast markings.

704-C: HOT THERMOPLASTIC MARKINGS

704-C.1 DESCRIPTION

This work consists of providing Materials, labor, and Equipment for placement of Hot Thermoplastic Pavement Markings, in substantial compliance with these Specifications and the current edition of the MUTCD, as shown in the Contract or as directed by the Project Manager.

704-C.2 MATERIALS

1. The Contractor shall supply a letter of certification from the manufacturer with each batch certifying the Material meets the requirements of the Departments current Specifications and, this section. Copies of this Specification are available from Traffic Services Engineer.
2. Reflectorized glass beads shall conform to the requirements of the Department's latest specifications for glass beads, Designation MGRB, Type DAB. Copies of this Specification are available from Traffic Services Engineer.

704-C.2.1 Material Sampling, Testing, and Acceptance of Materials

The Contractor shall furnish the Project a manufactures certification for Hot thermoplastic Materials. For glass beads, a certificate with reference to the State Materials Bureau test control number, indicating that the glass beads provided to the Project have been tested and Accepted by the State Materials Bureau, verifications of the certification will be made by Project personnel checking the batch or lot number on the glass beads furnished to the Project.

Glass beads will conform to applicable statements of Section 704.2, "Material;" Sampling, Testing, and Acceptance of Materials.

The Department will reduce payment for or reject hot thermoplastic pavement markings or glass beads used before submitting the proper documentation, if the test results do not meet the Specifications.

704-C.2.2 Material Packaging

The thermoplastic Material shall be delivered in cardboard containers or plastic bags of sufficient strength to permit normal handling during shipment and handling on the job without loss of Material. The net weight of each container shall be approximately 50–55 pounds. When supplied in bags the construction of the bag shall be such that it can be placed into the melted with the thermoplastic striping Material to become part of the finished product.

Each container shall be clearly marked to indicate the color of the Material, the process batch number, the manufacturer's product number, the manufacturer's name and address and the date of manufacture.

704-C.3 CONSTRUCTION REQUIREMENTS

The Contractor shall place the Hot Thermoplastic and glass beads on the Roadway surface using a hot thermoplastic pavement marking machine. Application shall be when the pavement surface is dry and the weather is not foggy, rainy, excessively windy, or otherwise detrimental to the application of markings. The Contractor shall remove excess asphalt or other deleterious substances, dirt, debris, grease, motor oils, rocks, or chips from the

pavement surface prior to applying markings.

Hot thermoplastic pavement markings shall be installed as per manufacturer's recommendation, when ambient air and Roadway surface, including wind chill, is at or above 60 degrees F and rising or as directed by Project Manager.

The Contractor shall provide the necessary personnel and equipment to divert traffic from the installation area while the Work is in progress and during the no track or drying time of the Pavement Marking Material.

704-C.3.1 Equipment for Hot Thermoplastic Markings

The machine shall be self-propelled and be able to install Hot Thermoplastic Pavement Marking Material in a molten state by a conventional extrusion ribbon gun at a minimum temperature of 400°F and a maximum temperature of 450° F. It shall also be equipped with an arrow board and warning lights sufficient to aid in traffic control. The Department will allow placing legends and symbols with other Equipment specifically designed for application of such makings or as approved by Project Manager.

The Contractor shall:

1. Use a machine capable of applying clearly defined markings within the designated width as specified on section 704.3.6, "Dimension Tolerances" on Project Plans or Standard Drawings.
 - a. The machine must be equipped with a device capable of producing various lengths of painted segments and gaps that does not vary more than six (6) inches for a 40 ft cycle.
 - b. The machine shall be equipped with air-operated ribbon extrude dies and glass bead dispensers capable of producing markings as per sec. 704.3.6, "Dimension Tolerances."

704-C.3.2 Application, Thickness and Glass Bead Rates

The Hot Thermoplastic Pavement marking Material shall be applied at a thickness of not less than 90 mils for long line markings on all roads and not less than 120 mils for cross walks, stop bars, legends & symbols or as designated on plan set. Makings dimensions as per section "704.3.6, "Dimension Tolerances."

Glass beads shall be applied to the surface of the molten Material immediately after application. The drop-on glass beads and shall be applied at a minimum rate of ten (10) pounds of glass beads per 100 square feet of line (ex. 300 linear feet of four (4) inch stripe and 200 linear feet of six (6) inch stripe).

The Project Manager will, at their discretion, measure the retroreflectivity of the markings using 30-M geometry in units of mcd/m2/lux. The markings will be measured within twenty-one (21) days of application. The measurements will be taken every ¼ mile per line and an average will be calculated for every-mile per line. See Table 704-C.3.2:1, "Minimum Initial Reflective Values for Hot Thermoplastic Markings for Tolerances."

**Table 704-C.3.2:1
Minimum Initial Reflective Values for Hot Thermoplastic Markings for Tolerances.**

White Hot Thermo Markings (mcd/m2/lux)	Yellow Hot Thermo Marking (mcd/m2/lux s)
250	175

704-C.3.3 Primer Application

Primer-sealers shall be used on all portland cement concrete surfaces and existing aged asphalt with exposed aggregate. The primer sealer shall be applied as recommended by the thermoplastic Material manufacturer and shall be compounded specifically for use with the specified thermoplastic Materials. Primer-sealer should not be used on new asphalt surfaces.

If interim or temporary striping is required on final mat and water borne traffic paint is utilized, seven (7) to 15 wet mils with beads reduced accordingly can be used or as per manufactures recommendation. This interim or temporary striping shall be in permanent marking alignment and paid for separately as required in the Contract.

704-C.3.4 Surface Preparation

All surfaces shall be clean and dry before thermoplastic or primer can be applied. Loose dirt and debris shall be removed by blowing compressed air over the area to be striped. If the thermoplastic is to be applied over existing painted lines that are poorly adhered to Roadway, the paint markings shall be swept with a mechanical sweeper or wire brush to remove any such areas that would interfere with the proper bonding of the thermoplastic. Hot thermoplastic should never be installed over Retroreflective Preformed Plastic Markings (Tape.)

Curing compound and loosely adhered surface film shall be removed from all new portland cement concrete surfaces by loose grain abrasive pressure blasting, mechanical abrasion, wire brushing or high pressure water blasting. A manufacturer's recommended primer shall be used on all concrete surfaces.

Prior to installing Hot Thermoplastic Markings, if curing compound requires removal or if existing pavement markings require complete removal, and is approved by the Project Manager, but not listed as a pay item in the Bidding schedule, it will be paid for in accordance with the provisions of Section 104.4, "Extra Work."

704-C.4 METHOD OF MEASUREMENT

The Department will measure Hot Thermoplastic Pavement Marking by four (4) inch, six (6) inch, eight (8) inch, 12 inch, and 24 inch widths using inch width to calculate a total length. Legends, symbols and specialty markings will be paid by each.

704-C.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Hot Thermoplastic Pavement Marking ____ inch</i>	Foot
<i>Hot Thermoplastic Pavement Marking Arrow, Type ____</i>	Each
<i>Hot Thermoplastic Pavement Marking Word (____)</i>	Each
<i>Hot Thermoplastic Pavement Marking Symbol, Type ____</i>	Each
<i>Hot Thermoplastic Pavement Marking Railroad Crossing ____</i>	Each

704-C.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Removal of temporary marking tape;

2. Repair or replacement of damaged striping due to Contractor's negligence or operations;
3. Furnishing, mixing, and applying adhesive or primers;
4. Standard surface preparation;
5. Maintaining and protecting the pavement markings from traffic during the marking operations.
6. Mobile traffic control operations for long line traffic marking operations; and
7. Black out line for contrast markings.

704-D PREFORMED THERMOPLASTIC PAVEMENT MARKINGS

704-D.1 DESCRIPTION

This work consists of providing Materials, labor, and Equipment for placement of Preformed Thermoplastic Markings in substantial compliance with these Specifications and the current edition of the MUTCD, as shown in the Contract or as directed by the Project Manager.

704-D.2 MATERIALS

The Contractor shall provide Preformed Thermoplastic Materials in accordance with the Department's current Specifications and this section. The preformed thermoplastic Material shall conform to AASHTO designation M249. Copies of this Specification are available from Traffic Services Engineer.

Prefabricated legends and symbols in accordance with the applicable shapes and sizes in the MUTCD, current edition. Thickness: The Material must be supplied at a minimum thickness of 90 mils (2.29 mm).

The markings shall consist of a resilient white or yellow preformed thermoplastic product with glass beads uniformly distributed throughout the entire cross sectional area. Material shall be capable of being affixed to bituminous pavements and or portland cement concrete pavements by heating. The markings shall conform to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The Material shall have resealing characteristics with the capability of fusing with itself and previously applied thermoplastic markings under normal use.

704-D.2.1 Acceptance of Materials for Preformed Thermoplastic

The Contractor shall supply a letter of certification from the manufacturer with each batch certifying the Material meets the requirements of this section.

The Department will reduce payment for or reject preformed thermoplastic pavement markings used before submitting the proper documentation, if the test results do not meet the Specifications.

704-D.2.2 Material Packaging

The preformed thermoplastic markings shall be packaged in a protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. The carton in which the Material is packed shall be clearly labeled with batch/lot number for ease of identification.

704-D.3 CONSTRUCTION REQUIREMENTS

704-D.3.1 Application

The ambient air and Roadway surface, including wind chill, shall be 32 degrees F and rising before application of preformed thermoplastic markings can begin, or as per manufacturer's recommendations. Pavement markings must be installed as per manufacturer's recommendation or as directed by Project Manager.

At the request of the Project Manager, the Contractor shall provide a copy of the manufacturer's installation recommendations prior to beginning the Work.

704-D.3.2 Equipment

The Contractor shall use a heating method specifically recommended by the manufacturer for the installation of preformed thermoplastic markings.

705-D.3.3 Primer Application

Primer-sealers shall be used on all portland cement concrete surfaces and existing aged asphalt with exposed aggregate. The primer sealer shall be applied as recommended by the thermoplastic Material manufacturer and shall be compounded specifically for use with the specified thermoplastic Materials. Primer-sealer should not be used on new asphalt surfaces.

704-D.3.4 Surface Preparation

All surfaces shall be clean and dry before preformed thermoplastic or primer can be applied. Loose dirt and debris shall be removed by blowing compressed air over the area to be marked. If the preformed thermoplastic is to be applied over existing painted lines that are poorly adhered to Roadway, the paint markings shall be swept with a mechanical sweeper or wire brush to remove any such areas that would interfere with the proper bonding of the thermoplastic. Preformed thermoplastic should never be installed over Retroreflective Preformed Plastic Markings (Tape).

Curing compound and loosely adhered surface film shall be removed from all new portland cement concrete surfaces by loose grain abrasive pressure blasting, mechanical abrasion, wire brushing or high pressure water blasting. A manufacturer's recommended primer shall be used on all concrete surfaces.

Prior to installing Preformed Thermoplastic Markings, if curing compound requires removal or if existing pavement markings require complete removal, and is approved by the Project Manager, but not listed as a pay item in the bidding schedule, it will be paid for in accordance with the provisions of Section 104.4, "Extra Work."

704-D.4 METHOD OF MEASUREMENT

The Department will measure Preformed Thermoplastic Pavement Marking by four (4) inch, six (6) inch, eight (8) inch, 12 inch, and 24 inch widths using inch width to calculate a total length. Legends, symbols and specialty markings will be paid by each.

704-D.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Preformed Thermoplastic Pavement Marking ____ inch</i>	Foot
<i>Preformed Thermoplastic Pavement Marking Arrow, Type ____</i>	Each
<i>Preformed Thermoplastic Pavement Marking Word (____)</i>	Each
<i>Preformed Thermoplastic Pavement Marking Symbol, Type ____</i>	Each
<i>Preformed Thermoplastic Pavement Marking Railroad Crossing</i>	Each

704-D.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Removal of temporary marking tape;

2. Repair or replacement of damaged striping due to Contractor's negligence or operations;
3. Furnishing, mixing, and applying adhesive or primers;
4. Standard surface preparation;
5. Maintaining and protecting the pavement markings from traffic during the marking operations;
6. Mobile traffic control operations for long line traffic marking operations; and
7. Black out line for contrast markings.

704-E RAISED AND RECESSED PAVEMENT MARKERS

704-E.1 DESCRIPTION

This work consists of providing Materials labor and Equipment for placement of Raised or Recessed Pavement Markings, in substantial compliance with these Specifications, the current edition of the MUTCD, as shown on the Plans, or as directed by the Project Manager.

704-E.2 MATERIALS

The Department will specify raised pavement markers as follows:

1. Type A = Non-reflective Circular White Marker;
2. Type AY = Non-reflective Circular Yellow Marker;
3. Type B = Two (2)-Way White Reflective Marker;
4. Type C = Red-White Reflective Marker;
5. Type D = Two (2)-Way Amber Reflective Marker;
6. Type G = One (1)-Way White Reflective Marker;
7. Type H = One (1)-Way Amber Reflective Marker;
8. Type J = Red-Amber Reflective Marker;
9. Type TC = Temporary Red-White Reflective Marker;
10. Type TD = Temporary Two (2)-Way Amber Reflective Marker;
11. Type TG = Temporary One (1)-Way White Reflective Marker;
12. Type TH = Temporary One (1)-Way Amber Reflective Marker;
13. Type TJ = Temporary Red-Amber Reflective Marker;
14. Type PC = Plowable Red-White Reflective Marker;
15. Type PD = Plowable Two (2)-Way Amber Reflective Marker;
16. Type PG = Plowable One (1)-Way White Reflective Marker;
17. Type PH = Plowable One (1)-Way Amber Reflective Marker; and
18. Type PJ = Plowable Red-Amber Reflective Marker.

704-E.2.1 Non-reflective Raised Pavement Markers

Types A and AY raised pavement markers consist of a heat-fired, vitreous, ceramic base and a heat-fired, opaque, glazed surface to produce the required properties. The Contractor shall provide markers produced from any suitable combination of uniformly mixed clays, shales, talcs, flints, feldspars, or other inorganic Materials that meet the required properties. The Contractor shall provide markers thoroughly and evenly cured and free from defects.

704-E.2.2 Non-Reflective Raised Pavement Markers: Finish Requirements

The Contractor shall provide non-reflective raised pavement markers in accordance with Table 704-E.2.2:1, "Non-Reflective Raised Pavement Marker Requirements."

**Table 704-E.2.2:1
Non-Reflective Raised Pavement Marker Requirements**

Test	Specific Intensity (mcd/lux/m2)	
	White (A)	Yellow (AY)

**Table 704-E.2.2:1
Non-Reflective Raised Pavement Marker Requirements**

Test	Specific Intensity (mcd/lux/m2)	
	White (A)	Yellow (AY)
Directional reflectance, Glazed surface (min)	≥75	n/a
Directional reflectance, Body of marker	≥65	n/a
Yellow Index, Glazed surface (min)	n/a	≤0.07
Yellow Index, Body of marker	n/a	≤0.12
Purity	n/a	76-96%
Dominant wave length	n/a	579-585μm
Total luminous reflectance (Y value min)	n/a	≥0.41
Autoclave resistance	n/a	Glaze shall not spall, craze, or peel
Strength (min)	n/a	≥1.5kip
Water absorption (max)	n/a	≤2.0%

704-E.2.3 Reflective Raised Pavement Markers

The Contractor shall provide the prismatic reflector type of reflective raised pavement markers consisting of a methyl methacrylate or suitably compounded acrylonitrile butadiene styrene shell that is filled with a mixture of an inert thermo-setting compound and filler Material. The Contractor shall ensure a smooth exterior surface of the shell containing one (1) or two (2) methyl methacrylate prismatic reflector faces of the specified color.

704-E.2.4 Reflective Raised Pavement Markers Requirements

If illuminated by a motor vehicle headlight, ensure the reflectors appear an approved white, yellow, or red in accordance with Table 704-E.2.4:1, "Reflectorized Raised Pavement Marker Requirements." The Department will reject markers with off-color reflection.

**Table 704-E.2.4:1
Reflectorized Raised Pavement Marker Requirements**

Test Reflectance	Minimum Retroreflectivity (mcd/lux/m2)		
	White	Yellow	Red
0 deg. Incidence Angle, Minimum	278	139	70
20 deg. Incidence Angle, Minimum Strength 2.0 kip	111	56	28

704-E.2.5 Temporary Reflective Raised Pavement Markers

The Contractor shall provide the prismatic reflector type of temporary reflective raised pavement markers consisting of either a high-grade polystyrene or acrylic plastic in accordance with Federal Specification LP-390C(2), Type I, Class 3. Ensure a smooth exterior surface of the shell containing one (1) or two (2) prismatic reflector faces of the specified color.

The Contractor shall provide a reflector of either polycarbonate microprism sheeting or prismatic air cell reflective lens. The Contractor shall provide a sealed, metallic backed reflector to prevent water penetration with a reflector face area of 1/2 inch.

704-E.2.6 Temporary Reflective Raised Pavement Markers Requirements

If illuminated by a motor vehicle headlight, ensure that the reflectors appear an approved white, yellow, or red in accordance with Table 704-E.2.6:1, "Temporary Reflective Raised Pavement Marker Requirements." The Department will reject markers with off-color reflection.

**Table 704-E.2.6:1
Temporary Reflectorized Raised Pavement Marker Requirements**

Test Reflectance	Minimum Retroreflectivity (mcd/lux/m ²)		
	White	Yellow	Red
0 deg. Incidence Angle, Minimum	93	46	---
20 deg. Incidence Angle, Minimum Strength 2.0 kip	37	19	---

704-E.2.7 Plowable Reflective Raised Pavement Markers

The Contractor shall provide a plowable reflective raised pavement marker with a prismatic retroreflector in accordance with this section.

704-E.2.8 Adhesive Requirements for Raised Pavement Markers

The Contractor shall use bituminous adhesive for the installation of permanent or temporary markers. The Contractor may substitute rapid-set epoxy adhesive or standard-set epoxy adhesive with approval from the Project Manager and at no additional cost to the Department.

704-E.3 CONSTRUCTION REQUIREMENTS

704-E.3.1 Application and Weather Limitations

The Contractor shall set the raised pavement markers to the alignment established by the Project Manager.

The Contractor shall place reflective markers so that the reflective face of the marker is perpendicular to a line parallel to the Roadway centerline. The Contractor shall not place pavement markers over longitudinal or transverse joints in the pavement surface.

The Contractor shall place the adhesive and markers in accordance with manufacturer's recommendations.

When installing temporary reflective raised pavement markers, the Contractor shall insure that they are easily removed without heating or diamond grinding, and without damage to the pavement surface.

704-E.3.2 Plowable Raised Pavement Markers

The Contractor shall accurately lay out the locations of saw-cut slots on the pavement as per Project Plans, mill or cut slots for the plowable raised pavement markers in accordance with the manufactures Specifications, install marker as per Section 704-E.3.1 "Application and Weather Limitations." The Contractor shall not install plowable markers on Bridge decks or concrete surfaces.

704-E.3.3 Equipment

The Contractor shall use Equipment recommended by the manufacturer for the installation of raised pavement markers. For recessed markers, the Contractor shall use Equipment capable of cutting or milling slot in asphalt pavement. Cuts should be smooth and machine should not damage surrounding Roadway surface.

704-E.3.4 Surface Preparation

For raised pavement markers, the Contractor shall clean by sweeping, high pressure air or water, the specified pavement locations of dirt, curing compound, grease, oil, moisture, loose, or unsound layers, paint, and Material that would adversely affect the adhesive's bond.

For recessed pavement markers, the Contractor shall ensure that saw cut slots for plowable raised pavement markers are dry and free of loose Material before applying the bituminous adhesive.

704-E.4 METHOD OF MEASUREMENT

The Department will measure reflective and non-reflective raised and recessed pavement markers by the each and will be paid by each.

704-E.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Reflective Raised Pavement Marker, Type ____</i>	Each
<i>Non-reflective Raised Pavement Marker, Type ____</i>	Each
<i>Temporary Reflective Raised Pavement Marker, Type ____</i>	Each
<i>Plowable Reflective Raised Pavement Marker, Type ____</i>	Each

704-E.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Furnishing, mixing, and applying adhesive or primers;
2. Standard surface preparation;
3. Maintaining and protecting the pavement markings from traffic during the marking operations; and
4. Mobile traffic control operations for long line traffic marking operations.

SECTION 705: GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND HIGHWAY LIGHTING SYSTEMS

705.1 DESCRIPTION

This Work consists of providing and installing complete and functioning Traffic Signal and lighting systems.

705.1.1 Definitions

Traffic-Actuated Controller. An electronic timing device that controls the timing and sequence of traffic phases in accordance with the varying demands of traffic registered by detectors.

705.2 MATERIALS

705.2.1 Signal and Lighting Materials

The Contractor shall provide new Materials, unless otherwise specified in the Contract.

The Contractor shall provide electrical Materials in accordance with NEMA standards, the NEC®, and State and local ordinances or requirements. If revisions to NEMA or NEC® requirements create a conflict with Material requirements, the Contractor shall apply the more stringent.

The Contractor shall provide signal and lighting systems complete with the necessary accessories for proper operation.

The Contract will specify the extent and general arrangement of signal and lighting systems. The Contractor shall complete the systems as specified.

705.2.1.1 Material Approvals

Within 15 Days of Contract execution, the Contractor shall submit a list of signal and lighting Materials proposed for use and their supply sources to the Project Manager for approval by the Traffic Technical Support Engineer.

The Contractor shall include Materials, identified in the Contract by performance characteristics, on this list with the following information about each item:

1. Name of the manufacturer;
2. Size;
3. Catalog number of each item; and
4. Other performance data (if required).

The Contractor shall include complete shop drawings and Material certifications in submittals for Standards (poles), including lowering devices for high masts. The Contractor shall provide Material certifications after part manufacture, but before erection.

If requested by the Project Manager or specified in the Contract, the Contractor shall submit samples of the proposed Material.

705.2.1.2 Prequalification

The Contractor shall use only Traffic-Actuated Controllers, controller cabinets, System Masters, signal monitors, vehicle detectors, load switches, signal Standards, and lighting Standards prequalified before Bid Opening.

The list of pretested and Acceptable signal items is on the Department's *Approved Products List* and is available on the NMDOT website. The Department lists each Acceptable item by manufacturer and model number or identification number.

705.2.2 Backfill Materials

The Contractor shall provide backfill Materials for signal and lighting system excavations within the Roadway Prism or for foundations, suitable for compaction in accordance with Section 210.3.2, "Compaction."

The Contractor shall backfill excavations for conduit or drilling pits outside the Roadway Prism with the Material removed from that excavation. The Contractor shall remove stones with diameters larger than four (4) inches, large pieces of concrete, vegetation, and other Deleterious Materials. The Contractor shall provide additional backfill Material, if necessary.

705.2.3 Pavement and Sidewalk Material

The Contractor shall provide pavement and Sidewalk replacements for signal and lighting system excavations in accordance with the Contract for the replacement of the Material removed.

705.3 CONSTRUCTION REQUIREMENTS

705.3.1 General

The Contractor shall ensure that the electrical Work is in accordance with the NEC® and applicable local ordinances. The Contractor shall obtain a permit (If applicable) from the State Electrical Board (or equivalent State or local agency) before construction. The Contractor shall provide permit proof to the Project Manager before Work begins on a new or relocating an existing service.

All electrical Work relating to the installation or preparation of installation of signals and lighting must be supervised by an on-site licensed journeyman electrician.

The Contractor shall obtain approval from the local power company for the exact location of the electric service before its installation.

Unless waived by authorizing agency, the Contractor shall submit evidence to the Project Manager that all electrical Work and installations have been inspected and approved by an authorized representative of the State Electrical Board or the Traffic Services Signal Laboratory.

The Contractor shall know the NEC® and local requirements and notify the Project Manager promptly of any conflicts with the Contract documents.

705.3.2 Excavation and Backfill

The Contractor shall perform the excavation required for the installation of conduit, foundations, and other items, minimizing damage to Highways, Streets, or Roads. The Contractor shall not excavate until immediately before the installation of conduit and foundations. The Contractor shall not cut the existing pavement, until the Project Manager

approves.

The Contractor shall perform compaction for Standard foundations in accordance with Section 210.3.2, "Compaction." The Contractor may use original Material, mechanically tamped, and neatly leveled to original grade, to backfill excavations in natural ground or out of defined Roadway Prism. In grassed or landscaped areas, the Contractor shall carefully remove sod before excavation and replace it after backfilling.

To prevent damage to conduit during backfilling, the Contractor shall place at least two (2) inches of fine-grained Material that passes a 3/8 inch sieve on the sides and above the conduit for the width of the trench. If the bottom of the trench contains rocks or Material the Project Manager determines to be unsuitable, the Contractor shall place at least two (2) inches of this Material below the conduit to cushion it.

705.3.3 Existing and Temporary Traffic Signals and Lighting Systems

The Contractor shall provide, install, and maintain temporary Traffic Signals and lighting systems, if specified in the Contract. The Contractor shall provide the Project Manager with access to power disconnects and control Equipment during this period.

705.3.3.1 Temporary Traffic Signals

Timing Plans for temporary Traffic Signals must be prepared by a professional Engineer registered and licensed by the State Board and must be submitted to the Traffic Technical Support Section for approval. The Contractor shall remove and retain ownership of temporary Equipment, unless otherwise specified in the Contract. The Traffic Operations Section will inspect the temporary Traffic Signals before their initial activation.

705.3.3.2 Coordination of Work with Existing Facilities

The Contractor shall keep existing signal and lighting systems in operation until the new Material is installed and ready for operation, unless otherwise specified in the Contract. The Contractor shall not start Work that may cause the existing signals to become inoperative until Materials for the new installation are on hand and the specified regulatory signing or temporary signals are in place and approved by the Project Manager and Traffic Services Engineer.

The Contractor shall schedule shutdowns in accordance with the construction traffic control Plan. The Contractor shall notify the Project Manager and the Maintaining Agency in writing at least five (5) Working Days before a scheduled shutdown.

When the Work requires additions or modifications to existing signal or lighting systems, give the Project Manager and the Maintaining Agency written notice at least five (5) Workings Days before any interruptions. The Contractor shall allow the Maintaining Agency to inspect the Work before and after re-energizing.

705.3.3.3 Salvage of Existing Material

The Contractor shall salvage the existing signal Material, including cabinets and cameras, and avoid damage in handling. The Contractor shall disassemble and deliver salvaged Material to the Department's Signal Laboratory or to the Contract specified location. The Department may require the Contractor to record/video recording Equipment prior to disassemble and packing. This Work will be considered Incidental to construction.

The Contractor shall coordinate with the local power company to remove salvaged

lighting Material. If specified in the Contract, the Contractor shall remove and deliver the Material to the required location.

705.3.3.4 Final Operations and Acceptance Requirements

After the signal is in operation and before Final Acceptance, the Contractor shall ensure that the signal remains fully operational in accordance with Section 105.18, "Acceptance."

If the signal malfunctions or is otherwise disabled, the Contractor shall notify the Project Manager, the Traffic Services Signal Laboratory, and the Maintaining Agency immediately, and provide emergency repairs.

New lighting systems or modifications to existing lighting systems require a 30-Day installation test in accordance with Section 705.3.5, "Testing."

705.3.4 Responsibility for Utility and Maintenance

The Contractor shall ensure that the Maintaining Agency is the customer of record for the electrical and communications utilities. The electrical energy and communications services cost, maintenance and operational responsibility for existing signal and lighting systems undergoing Contract modifications will remain with the Maintaining Agency, unless otherwise directed in the Contract.

The Contractor shall continue maintenance of new signals and lighting systems until partial or Final Acceptance of the Project. The electrical and communication costs of the signal and lighting systems shall be borne by the Contractor until Acceptance of the system by the Department, after which the cost will become the responsibility of the Maintaining Agency. The Contractor will be reimbursed for actual energy and communication services costs and costs of permit transfer per Section 705.5, "BASIS OF PAYMENT." The Contractor shall submit an appropriate billing verification to the Project Manager.

After partial or final Acceptance of the Project, the Maintaining Agency is responsible for the signal and lighting systems' operations and maintenance.

705.3.5 Testing

705.3.5.1 Wiring Tests

Before the Department's Acceptance of the Work, the Contractor shall perform the following tests on the lighting and signal circuits:

1. Continuity of each circuit;
2. Grounds or shorts in each circuit;
3. Functional test to demonstrate that all parts of the system function as specified or intended; and
4. When requested, conduct a megger test of each circuit between the circuit and ground, including the insulation resistance for all vehicle loops, direct burial wire, or cable.

The Contractor shall ensure that the initially applied voltage for the tests is:

1. No greater than the rated voltage of the cables; and
2. Has a uniform rate of increase, of not more than 100% in ten (10) s or less than 100% in 60 s.

The Contractor shall replace or repair faults in Materials or in any part of the installation revealed by these tests, as approved by the Project Manager. The Contractor shall repeat the same test until no fault appears. The Contractor shall perform the tests in the presence of the Project Manager and/or Signal Laboratory personnel or both, as directed. The Contractor shall provide all electrical power, instruments, and personnel required for the test.

705.3.5.2 Operation Tests

The Department requires a 30-Day operational test period, which starts when the Lighting System are completely installed and fully operational. The Contractor shall submit a request for approval to start the 30-Day operational test period, in writing, to the Project Manager and the Traffic Services Engineer.

The Department will grant partial Acceptance of the system upon satisfactory completion of the 30-Day operational test period and will grant Final Acceptance in accordance with Section 105.18, "Acceptance."

The Contractor shall shop-test the controllers in accordance with Section 714.3.2, "Testing."

The Contractor shall ensure that timing for signal controllers during the installation test period is as specified in the Contract. The Contractor shall not place a signal in operation until the Traffic Services Engineer verifies the time settings and the correctness of signal indication outputs. The Contractor shall provide access to the signal controller for the Inspector during the test period.

705.4 METHOD OF MEASUREMENT—Reserved

705.5 BASIS OF PAYMENT

Signal/Lighting System Start-up Costs will be paid for the actual cost incurred.

The Contractor shall provide the Project Manager with a detailed cost breakdown, including receipts and invoices of actual costs incurred.

For the purpose of bidding, the Department will enter into the Bid Schedule a fixed amount for Signal/Lighting System Start-up Costs.

Pay Item	Pay Unit
<i>Signal/Lighting System Start-up Costs</i>	Allowance

Furnishing and installing of Traffic Signal and lighting systems will be measured and paid for, as provided in the applicable sections of these Specifications, for the Work specified in the Contract.

705.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Allowed costs required for energy and communication service for the energy/communication permit fees, and energy/communication permit transfer fees.

SECTION 706: SIGNAL AND LIGHTING SERVICE SYSTEMS

706.1 DESCRIPTION

This Work consists of bringing electricity to the Project (Power Service Installation), providing and installing service poles, service connections, and lighting control cabinets.

706.2 MATERIALS

706.2.1 Service Pole

The Contractor shall use timber poles treated in accordance with AASHTO M 133 or AWWA Standard U1, Commodity Standard D: Poles.

The Contractor shall provide service requirements for Traffic Signals and Lighting Systems. The Contractor shall provide service in accordance with the Plans or as required by the servicing utility.

The Contractor shall provide a circuit breaker type service switch or a type HD disconnect switch with fuses. The Contractor shall enclose the service switch in a NEMA rain-tight housing with a hinged cover. The Contractor shall ensure the cover stays in position when open and has a hasp for a padlock. The Contractor shall provide UL-approved switches and housings.

706.2.2 Service Riser

The Contractor shall provide the service in accordance with the Plans or as required by the servicing utility.

706.2.3 Meter Pedestal

The Contractor shall provide Materials for meter pedestals in accordance with the NEC® and the following:

1. Provide meter pedestals made of 12-gauge hot dipped galvanized steel, 1/8" aluminum, or 304D stainless steel;
2. Fully welded construction with welding Material specifically designed for Material used;
3. All fasteners, latches, and hardware are made of stainless steel and all hinges are continuous interior or piano style;
4. No exposed nuts, bolts, screws, rivets or other fasteners on the exterior;
5. Fully framed side hinged cabinet doors equipped with neoprene flange compressed gaskets and 2,000lb stress rated hasps;
6. Enclosure shall be factory wired and conform to required NEMA and UL 508A Standards;
7. Provide a meter socket with a minimum rating of 100 A or 200 A as required in the Contract or the demand of the system;
8. Main breakers shall be one (1), two (2), or three (3) poles;
9. Provide separate metered main, lighting main & disconnects as required;
10. Cable in/cable out circuit breakers Standard;
11. Circuit breakers installed in a vertical position handle up for on, handle down for off;
12. Circuit breakers are industrial grade, full rated;

13. All bussing is UL approved copper cable bussing, fully rated;
14. Distribution panel with deadfront panel and ¼ turn latch;
15. Wiring will be NEMA IIB Standards showing connections to external Equipment;
16. Control wiring is 19 strand #12 or #14 AWG MTW;
17. Functions of circuit breakers, switches and other components as required shall be clearly identified by engraved nameplates; and
18. As-built factory drawings enclosed.

706.2.4 Service Connection

The Contractor shall provide service connections to transformers and power sources in accordance with the Plans and the NEC®.

706.2.5 Lighting Control Cabinet

The Contractor shall provide Materials for lighting control cabinets in accordance with the Plans, the NEC®, and the following:

1. Cabinets of 14-gauge steel with a corrosion-resistant durable finish;
2. Ground-mounted, tamper-proof, lockable cabinets approved by the Rural Electrification Administration;
3. Stainless steel cabinet hardware, including the hinges;
4. Mounting brackets for attaching contactors, photoelectric cells, junction boxes, and other auxiliary Equipment; and
5. Enclosure shall be factory wired and conform to required NEMA and UL 508A Standards.

706.2.6 Photoelectric Controller

The Contractor shall provide a photoelectric unit that consists of a light sensitive element connected directly to an internal control relay without intermediate amplifications. The Contractor shall provide either the horizontal sensing or zenith sensing type of unit with turn-on at 1.5 fc ± 0.5 fc and a turn-off at a maximum of 5.6 fc. The minimum Acceptable difference between turn-on and turn-off is 0.8 fc. The minimum Acceptable load rating is 1,800 W (HID load).

The Contractor shall provide the unit base with a three (3)-prong, NEMA Standard, twist lock type plug mounting so that the unit mounts directly on Luminaires, or with an adapter base, on pole tops or sides. The Contractor shall ensure that the controllers normally Work in conjunction with external auxiliary load relays for handling the required lighting loads.

The Contractor shall ensure that the supply voltage rating is the same as the system voltage specified in the Contract. The minimum operating temperature range is from -40 °F to 140 °F. The Contractor shall ensure that the power consumption of the controller is less than 12 W.

The Contractor shall ensure that the lighting load turns on when the north sky illumination in the area falls to a preset value. The Contractor shall provide a potentiometer that is easily accessible for adjustment to vary the turn-on value within the operating range. The Contractor shall incorporate a time Delay into the circuit to prevent streetlights from turning off at night when transient lights are focused on the controller. The Contractor shall ensure that the controlled lighting load remains on or becomes energized, if any functional failure occurs in the

electronic circuit. The Contractor shall equip the controller with a lightning arrestor capable of handling 500 V at 35,000 A.

706.2.7 Auxiliary Contactor

The Contractor shall ensure that the auxiliary Contactor has the following properties:

1. Works in conjunction with a photoelectric controller and the specified lighting loads;
2. Is normally open and double pole; and
3. Is the electrically held type, designed to withstand lamp load inrush current and to carry full rated current on a continuous basis.

The Contractor shall provide a three (3)-position switch to permit manual operation of the lighting circuit with an indicating nameplate reading "PHOTO-OFF-MANUAL." The Contractor shall use a toggle or rotary type switch with double-pole, triple-throw, and center-off position.

706.3 CONSTRUCTION REQUIREMENTS

706.3.1 General

The Contractor shall pay the local power company for Power Service Installation. The Contractor shall obtain a detailed estimate from the local power company.

The electrical service points shown in the Contract are approximate. The Contractor shall obtain the exact locations from the electric utility. The Contractor shall obtain approval of the final location from the Project Manager before beginning the service installation Work. If a major change in location from that specified in the Contract is necessary, the Project Manager will determine the final location and adjust the service run.

The Contractor shall obtain the necessary permits and schedule electrical inspections required for service attachment. The Contractor shall obtain the approval of the Project Manager before hook-up.

The Contractor shall provide the electric utility with the name of the Maintaining Agency, as the customer of record, in accordance with Section 705.3.4, "Responsibility for Utility and Maintenance."

706.3.2 Service Pole Installations

The Contractor shall attach the conduit to the pole, as specified in the Contract. The Contractor shall securely mount the conduit to the pole surface and bond it to the service pole ground system, as required by the NEC®.

The Contractor shall provide and install conduits, covers, gaskets, switches, fittings, and necessary Equipment. The Contractor shall refer to the Contract for layout, connections, and mounting details of the various switches and associated Equipment.

The Contractor shall use rigid steel, galvanized conduit of the specified size for above ground service installations. Where rigid steel conduit is coupled to rigid PVC conduit used for the underground portion of the service run, the Contractor shall join the conduits underground at a depth of from two (2) inches to ten (10) inches below the surface.

The Contractor shall provide and install meter sockets required by the serving utility company as specified in the Contract. The serving utility company will supply and install the meters.

706.3.3 Service Riser

The Contractor shall install service risers on existing poles at the required locations, in accordance with Section 706.3.2, "Service Pole Installations." The Contractor shall install service risers on the quadrant of the existing pole directed by the service utility company.

706.3.4 Meter Pedestal

The Contractor shall install meter pedestals at the locations specified and in accordance with the Contract. The Contractor shall install the pedestals at least ten (10) ft from the service pole.

706.3.5 Power Service Installation

The Contractor shall coordinate with the local public agency (LPA) and the utility company prior to service connection.

706.3.6 Lighting Control Cabinets

The Contractor shall install the lighting control cabinets at the locations specified in the Contract or as directed by the Project Manager. The Contractor shall install the cabinets plumb on a concrete foundation with necessary grout or caulking to provide a weather-resistant, dust-tight installation.

706.4 METHOD OF MEASUREMENT

Power Service Installation will be paid for complete in place.

706.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Service Pole</i> ____ (type)	Each
<i>Service Riser</i> ____ (type)	Each
<i>Meter Pedestal</i> ____ (type)	Each
<i>Lighting Control Cabinet</i>	Each
<i>Power Service Installation</i>	Lump Sum

For Power Service Installation the Contractor shall be paid the actual amount charged by the local power company for the Work.

706.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. All Materials required for a complete installation including meter sockets and disconnect switches, if required;
2. Concrete pads for lighting control cabinets; and
3. Service connections and Power Service Installation coordination will be considered as included in the cost of the main items and will not be measured or paid for separately.

SECTION 707: SIGNAL AND LIGHTING STANDARDS

707.1 DESCRIPTION

This Work consists of providing and installing Traffic Signal and Street lighting Standards. If the Contract specifies Standards provided and installed by others, this Work only consists of the installation of anchor bolts.

707.2 MATERIALS

A Standard consists of the following:

1. Shaft with base;
2. Anchor bolts;
3. Mast arms, if required; and
4. Other hardware supporting the Traffic Signal and Highway lighting apparatus.

The Contractor shall provide Structures in accordance with NMDOT Standard Serials and designed in accordance with the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (current edition)*.

707.2.1 Type I Standard

A Type I Standard is a pedestal-type support for Traffic Signals, controller cabinets, and splice cabinets. The Contractor shall provide a threaded pole pedestal-type support with a threaded (female) square cast aluminum base and collar assembly with set screws and ground lug. The Contractor shall provide an aluminum base approximately 15 inches high with a covered hand hole at least eight (8) inches × 18 inches.

The Contractor shall fabricate the pole from four (4) inches nominal diameter spun aluminum pipe, as per the Standard Drawings.

The Contractor shall provide a Type I Standard designed to support a post top-mounted Traffic Signal controller or splice cabinet weighing 150 lb. The Contractor shall design a Type I Standard four (4) ft high or less for a projected area of five (5) ft². The Contractor shall design a Type I Standard ten (10) ft high or more for a projected area of 15 ft².

707.2.1.1 Type I Standard, 4 ft

The Contractor shall provide a four (4) foot Type I standard with breakaway base for push button station.

707.2.2 Type II Standard

A Type II Standard is a mast arm Traffic Signal support. The Contractor shall provide Standards either with a monotube (single member) arm design fabricated from steel or a "trombone" truss arm design fabricated from steel. The Contractor shall provide Standards in accordance with the member attachment and size details specified in the Contract to ensure interchangeability and standardization between Fabricators.

707.2.2.1 Design Requirements

The Contractor shall provide a Standard installation designed to support Traffic Signal heads, back plates, dampers, and signing attached rigidly to the end of the arm. The

Contractor shall use a design-projected area of 12 ft² each and a design weight of 150 lb each.

707.2.2.2 Shaft

The Contractor shall provide steel shafts fabricated from a weldable-grade hot rolled steel, having a yield point after fabrication of at least 55,000 psi and a 0.3125-inch, minimum wall thickness.

The Contractor shall provide a round or octagonal cross section shaft, tapered at a constant rate. After fabrication, the Contractor shall hot-dip galvanize the steel shaft in accordance with ASTM A 123 and clean to provide a uniform and stain free surface. The Contractor shall provide a design for octagonal cross sections with a recording rate of 0.14inch/ft.

The Contractor shall provide a shaft with a removable pole top cap or mast arm hand hole with cover to allow access for pulling cable through the shaft.

707.2.2.3 Arm

The Contractor shall provide monotube (single member) arms fabricated from steel and "trombone" truss arms fabricated from steel. For the shaft, the Contractor shall provide steel members with a minimum thickness of 0.3125 inch.

707.2.2.4 Transformer Base

The Contractor shall provide steel transformer bases fabricated from hot rolled mild steel with a yield point of at least 33,000 psi and a sidewall thickness of at least a No. 7 U.S. Std. Ga., 0.1793 inch. The Contractor shall galvanize the steel transformer base after fabrication in accordance with ASTM A 123.

The Contractor shall provide bases with a height of at least 20 inches and, in one (1) side, a hand hole with cover at least eight (8) inch × 12 inch.

The Contractor shall provide transformer bases designed to allow the shaft to rotate a full 90° and to align irrespective of anchor bolt placement.

707.2.2.5 Hardware

The Contractor shall provide either steel or stainless steel hardware. The Contractor shall provide steel hardware in accordance with ASTM A 449, galvanized in accordance with ASTM F 2329. The Contractor shall provide stainless steel hardware in accordance with AISI Series 300 stainless steel.

707.2.2.6 Anchor Bolts

The Contractor shall provide anchor bolts in accordance with Section 707.2.7, "Anchor Bolts." The Contractor shall thread the top of each Type II Standard anchor bolt at least eight (8) inches and hot-dip galvanize the full thread plus six (6) inches.

707.2.3 Type III Standard

Type III Standard is a combination mast and Traffic Signal and Roadway Luminaire support. The Contractor shall provide Type III Standards fabricated from steel in accordance with Section 707.2.2, "Type II Standard." The Contractor shall provide Type III Standards that support a Luminaire with a shaft extension and arm. The Contractor shall provide arms

designed to support a Luminaire of 39 lb and a projected area of 1.1 ft².

The Contractor shall provide shaft extensions in accordance with Section 707.2.2.2, "Shaft," except that steel shaft extensions may have a minimum thickness of 0.3125 inch.

707.2.4 Reserved

707.2.5 Type V Standard

A Type V Standard is a mast arm Luminaire support. The Contractor shall provide Type V Standards of recording shafts with davit-type mast arms. The Contractor shall provide Breakaway bases in accordance with Section 707.2.5.4, "Breakaway Bases."

707.2.5.1 Design Requirements

The Contractor shall provide arms designed to support a Luminaire weighing 55 lb and a projected area of 2.7 ft².

The Contractor shall ensure pole straightness is in accordance with Table 707.2.5.1:1, "Type V Standard Pole Straightness Tolerances."

Table 707.2.5.1:1
Type V Standard Pole Straightness Tolerances

Total mounting height (ft)	Straightness (inch)
20	3/4
30	1
35	1 1/4
40	1 1/2
50	1 3/4

The Contractor shall limit dead load deflection in accordance with AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (current edition)*, subsection 1.9.1(B) 2a.

707.2.5.2 Fabrication Requirements

The Contractor shall fabricate Standards using spun aluminum or galvanized steel.

707.2.5.2.1 Spun Aluminum Standards

707.2.5.2.1.1 Shaft

The Contractor shall provide shafts of one (1)-piece, seamless recording tubes of alloy 6063 T6, in accordance with ASTM B 221 and having:

1. Wall thickness of at least 5/32 inch for mounting heights of equal to or less than 33 ft;
2. Wall thickness of at least 3/16 inch for mounting heights of from greater than 33 ft to 40 ft;
3. Wall thickness of at least 0.219 inch for mounting heights greater than 40 ft; and
4. No longitudinal welds and only two (2) circumferential welds located at the joint between the shaft and the anchor base.

The Contractor shall secure a one (1)-piece cast aluminum anchor base of alloy 356-T6, in accordance with ASTM B 108, to the base. The Contractor shall finish exposed edges of the plate that makes up the base assembly; smooth and furnish each base with four (4) bolt covers.

The Contractor shall provide a rotary sand polished shaft, wrapped for protection during handling and shipping.

707.2.5.2.1.2 Mast Arm

The Contractor shall provide mast arms of seamless aluminum tubing, alloy 6063-T6. The Contractor shall assemble arms with a slip fitter onto the main shaft and hold with through bolts and set screws.

707.2.5.2.1.3 Hardware

The Contractor shall provide stainless steel hardware.

707.2.5.2.1.4 Welding

The Contractor shall perform welding in accordance with the *Aluminum Design Manual*, published by the Aluminum Association.

707.2.5.2.2 Galvanized Steel

707.2.5.2.2.1 Shaft

The Contractor shall provide steel shafts with a yield strength of at least 40,000 psi after fabrication and a minimum wall thickness of No. 10 U.S. Std. Ga., 0.1345 inch. For shafts with an after-fabrication yield strength of 55,000 psi or greater, the Contractor may provide shafts with a minimum wall thickness of No. 11 U.S. Std. Ga., 0.1196 inch. The Contractor shall provide a round cross section shaft, reconditioned at a constant rate. The Contractor shall ensure the shaft is a one (1)-piece section, attached by two (2) circumferential welds to a base plate.

The Contractor shall provide a base of either one (1)-piece steel casting or fabricated from steel plate with a minimum yield strength of 36,000 psi.

707.2.5.2.2.2 Galvanizing and Finishing

The Contractor shall ensure exposed welds, except fillet welds, are ground flush with the base metal. The Contractor shall fully galvanize steel poles after fabrication in accordance with ASTM A 123. After galvanizing, the Contractor shall clean poles to provide a uniform and stain-free surface.

707.2.5.2.2.3 Mast Arm

The Contractor shall provide arms fabricated from the same Material as the shaft and with a wall thickness of at least No. 11 U.S. Std. Ga., 0.1196 inch. The Contractor shall assemble arms with a slip fitter onto an adapter casting fixed to the main shaft and held with through bolts and set screws.

707.2.5.3 Anchor Bolts

The Contractor shall thread the top of the anchor bolts for approximately nine (9) inches

and galvanize for a minimum of 12 inches. The Contractor shall provide each anchor bolt for Type V Standards with nuts and washers, as required for a Breakaway base, or one (1) nut, washer, and shims, if an anchor type base is required.

707.2.5.4 Breakaway Bases

The Contractor shall provide Type V Standards designed to meet the requirements for dynamic performance under vehicle impact and strength tests in accordance with AASHTO *Standard Specifications for Highway Signs, Luminaires and Traffic Signals (current edition)*. The Contractor shall use Type V Standards located behind barriers, Bridge railing, or Sidewalks requiring anchor bases for direct, rigid mounting. The Contractor may use Breakaway couplings or a steel slip-base system for Type V Standards. The Contractor may use either an integral aluminum base or Breakaway couplings for aluminum Standards.

If the total weight of the Standard and the Luminaire assembly exceeds 600 lb or, if requested by the Project Manager, the Contractor shall provide test data obtained in accordance with the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (current edition)*.

The Contractor shall provide Breakaway couplings designed for placement between the anchor bolts and the pole base composed of a frangible Material that breaks away under impact (shear). The Contractor shall ensure that the tensile and compressive strengths of the coupling equal or exceed those required for the design wind loading of the furnished Type V Standard. The Contractor shall include a sheet metal "skirt" base cover for the coupling installation as specified.

707.2.6 Type VI Standard

A Type VI Standard is a high mast Luminaire support. The Contractor shall provide Structural Steel for Type VI Standards, anchor bolts, base plates, shafts, and suspension arms in accordance with the applicable AASHTO, ASTM, or Military Specifications. The Contractor shall identify the AASHTO, ASTM, or Military Specifications for each member on the shop drawings and in the design calculations.

The Contractor shall ensure that all Structural Steel used in base plates and shafts more than 1/2 inch thick is in accordance with AASHTO Specifications for the Charpy "V" notch toughness in Zone 2.

The Contractor shall fabricate, transport, and erect Type VI Standards in accordance with Section 541.3, "Construction Requirements." The Contractor shall base the design on a wind velocity of 90 mph with a 1.14 gust factor.

707.2.6.1 Design

The Contractor shall design the installation to support Luminaires weighing 85 lb each, with a projected area of 3.4 ft² each. The Contractor shall base the design on the number of Luminaire positions specified in the Contract, assuming one (1) Luminaire in each position. The Contractor shall submit eight (8) copies of the design calculations and shop drawings to the Project Manager for review and approval by the State Bridge Engineer. The Contractor shall not begin fabrication until the State Bridge Engineer approves the design calculations and shop drawings.

707.2.6.1.1 Slip-Fit Design

The Contractor shall provide shafts consisting of round or multi-sided telescoping,

recordingred sections, designed to create a minimum overlap of sections of 1.5 times the outside diameter of the female sections. The Contractor shall mate sections and match-mark before shipment to the job site. The Contractor shall not allow the centerline alignment of an assembled shaft to vary from the theoretical centerline of the joining base and tip by more than three (3) inches.

707.2.6.1.2 Hand Hole

The Contractor shall provide a minimum 11 inch × 30 inch hand hole reinforced with a flange plate for each shaft, located near the base of the shaft. The Contractor shall design the reinforcing so that the original strength of the shaft is maintained. The Contractor shall provide the shaft with a weatherproof door and provisions for hand-locking. The Contractor shall provide stainless steel securing hardware.

707.2.6.1.3 Weld Joint Details

The Contractor shall use full penetration welds. The Contractor shall ensure that longitudinal welds, other than in the slip joint area, have 75% minimum weld surface penetration.

The Contractor shall test and inspect all circumferential welds joining shaft sections, longitudinal welds in the female slip joint area, suspension arm to shaft connection welds, and pole to base plate connection welds using ultrasonic techniques. The Contractor shall use magnetic particle or visual inspection on all other welds.

707.2.6.1.4 Protective Coating

The Contractor shall provide galvanizing in accordance with the requirements of AASHTO M-111-94. The Contractor shall ensure that galvanized coatings are uniform and bright. The Contractor shall fabricate Standards completely before galvanizing. The Contractor shall ensure that no embrittlement, warpage, and distortion occur, in accordance with ASTM A 143 and ASTM A 384.

707.2.6.1.5 Base Plate

The Contractor shall integrally weld the base plate to the pole shaft with a backing ring using an AWS prequalified 100% penetration weld. The Contractor shall provide a hole with at least a 16-inch diameter in the base plate to allow insertion of a lowering device into the hole through the base plate.

707.2.6.1.6 Anchor Bolts

The Contractor shall provide anchor bolts for each Type VI Standard according to ASTM F 1554; Grade 55 steel, or AASHTO M-314. The Contractor shall provide one (1) leveling nut, one (1) hold-down nut, and washers for each anchor bolt, top and bottom. The Contractor shall galvanize the threaded ends of the bolts, nuts, and washers in accordance with ASTM A 153. The Contractor shall space the anchor bolts in accordance with the manufacturer's recommendations.

707.2.6.2 Luminaire Frame and Lowering Device

The Luminaire frame and lowering device consist of a head frame, a Luminaire ring, a winch, a hoisting assembly, a circuit breaker, a portable power unit, and other necessary appurtenances (including wiring) to mount, operate, lower, raise, and test Luminaire fixtures.

The Contractor shall provide design of frame and lowering device to the State Bridge Engineer for approval.

707.2.6.2.1 Head Frame

The head frame structure supports the hoist cable sheaves, symmetrically spaced, and the power cable sheave, placed midpoint between two (2) hoisting cable sheaves. The Contractor shall cover the head frame with a firmly attached copper free aluminum cover. The Contractor shall fabricate the Structure from 1/4-inch ASTM A 36 steel plate that is hot-dip galvanized in accordance with ASTM A 123. The Contractor shall attach the head frame to the pole with a steel slip-fitter, and secure with stainless steel set screws.

The Contractor shall provide press-fit oil-impregnated sintered bronze bushings at the hub for all sheaves. The Contractor shall provide keepers to prevent the lift and power cables from riding out of the sheaves or roller assemblies during erection and operation. The Contractor shall provide design of the head frame to the State Bridge Engineer for approval.

707.2.6.2.2 Luminaire Ring

The Contractor shall construct the Luminaire ring of six (6) inches, 8.2-pound single-piece channel with the appropriate number of two (2) inch nominal steel pipe mounting arms, symmetrically mounted. The Contractor shall hot-dip galvanize after fabrication.

The Contractor shall pre-wire the ring with a suitable number of conductors having a current-carrying capacity of the total load with a maximum voltage drop of three percent (3%) and with 105C type SEO distribution cable.

The Contractor shall provide a protective roller system for the inner portion of the lowering ring to permit the ring to contact the pole shaft during raising and lowering operations, to prevent damaging either the ring or the pole. The Contractor shall use rollers consisting of water-resistant, non-marking Material with oil-impregnated bronze bushings on stainless steel shafts.

The Contractor shall provide three (3) high-visibility reflector indicator flags for the Luminaire rings, visible from the ground after mounting. The Contractor shall ensure that the Luminaire ring properly engages the head frame, so the flags trip to signal the operator. The Contractor shall provide design of the luminaire ring to the State Bridge Engineer for approval.

707.2.6.2.3 Hoisting Cable

The Contractor shall support the Luminaire ring with three (3) (3/16-inch diameter) stainless steel 19 × seven (7) strand non-rotating aircraft cables (Military Spec.: MIL-W-83420) with a minimum breaking strength of 3,700 lb. The Contractor shall anchor the ends of the cables in the Standard to the top of the suspension bracket.

The Contractor shall pass the lift cable up through the pole shaft, over the head frame sheaves, to the Luminaire ring; lead through guides and a compression spring, and terminate with a collect-type device. The Contractor shall prevent twisting and eliminate torsion developed during the initial installation of the hoisting cable system. The Contractor shall provide design of the hoisting cable to the State Bridge Engineer for approval.

707.2.6.2.4 Safety Mechanism (Latching Device)

The Contractor shall provide a safety mechanism that allows disengagement of the winch assembly in the base of the pole, consisting of two (2) multi-point safety chain and hook

assemblies to maintain the tension on the transition assembly. The Contractor shall galvanize the chain and hooks. The Contractor shall secure each chain to a plate welded to the inside of the pole shaft. The Contractor shall ensure that the safety mechanism is self-contained within the pole and independent of the pole foundation. The Contractor shall provide design of the latching device to the State Bridge Engineer for approval.

As an alternate to the above safety mechanism, the Contractor may provide a top latch returning system, as recommended by the manufacturer. The Contractor shall submit the shop drawings and design calculations for the lowering device to the Project Manager for preapproval of the system by the Lighting and Signal Engineer. The Contractor shall not begin fabrication until the Lighting and Signal Engineer reviews and approves the design and shop drawings.

The Contractor shall fabricate the safety mechanism, cams, and all hardware on the support ring of stainless steel.

707.2.6.2.5 Winch

The Contractor shall provide a worm-gear reducer type winch with a self-locking reduction ratio in both raising and lowering operations. The Contractor shall provide a winch drum rewound with stainless steel 19 × seven (7) strand, 1/4-inch diameter, aircraft cable (Military Spec.: MIL-W-83420). The Contractor shall provide manufacturing details, load ratings, anticipated winch loadings and winch Specifications to the State Bridge Engineer for approval.

The Contractor shall ensure that the winch has an ultimate strength of five (5) times the lifted load, if measured with the appropriate number of layers of cable on the drum. The Contractor shall provide a transition design to prevent twisting of support cables, to ensure smooth winding of the cable on the winch, and to prevent binding on the inside of the tower shaft. The Contractor shall provide a winch cable of sufficient length to maintain at least four (4) complete wraps on the winch drum, once the system has been lowered to its lowest point.

707.2.6.2.6 Electrical

The Contractor shall use 3/c, #10 AWG (4/c if three (3)-phase circuit is specified) Type SO portable power cable for the main power cable, unless otherwise specified in the Contract.

The Contractor shall securely connect power cables to a weathertight wiring box on the Luminaire ring and terminate on a 600-volt terminal block. The Contractor shall provide a twist lock power receptacle to allow testing of the Luminaires in the lowered position.

The Contractor shall provide a breaker complete with a NEMA 1 enclosure, accessible through the hand hole in each Standard. The Contractor shall size the breaker as follows:

1. Two (2) - pole, 30 A for 240 V, single-phase;
2. Two (2) - pole, 20 A for 480 V single-phase; and
3. Three (3) - pole, 15 A for 480 V, three (3)-phase.

The Contractor shall provide the type of service specified in the Contract. The Contractor shall provide design of the electrical system to the State Traffic Engineer for approval.

707.2.6.2.7 Hardware

The Contractor shall fabricate all miscellaneous fittings, fastenings, or hardware for the support head frame and Luminaire-mounting ring of AISI Series 300 stainless steel with

approved means for locking nuts. The Contractor shall provide Hardware design to the State Bridge Engineer for approval.

707.2.6.2.8 Portable Power Unit

The Contractor shall incorporate the drive motor, torque limiter, drive shaft, and electrical controls in the portable power unit. The Contractor shall provide a power unit that one (1) person can install, operate, and remove. The Contractor shall provide a drill motor controlled by a reversing switch connected by a 20 ft remote cord. The Contractor shall use gasket-type cord grips to prevent damage to the flexible cords. The Contractor shall provide design of the Power unit to the State Traffic Engineer for approval.

707.2.7 Anchor Bolts

For Type VI Standards, the Contractor shall provide anchor bolts in accordance with Section 707.2.6, "Type VI Standards." The Contractor shall fabricate anchor bolts of sufficient size and length to support the Structure with the design loads. The Contractor shall use high-strength steel bars, with a guaranteed minimum yield strength of 55,000 psi, or steel in accordance with ASTM F-1554.

The Contractor shall provide one (1) leveling nut and one (1) hold-down nut with each bolt. The Contractor shall provide each anchor bolt with nuts and washers, as required.

707.2.8 State-Furnished Materials

If specified in the Contract, the Department will provide the Standards and mast arms at specified locations.

707.3 CONSTRUCTION REQUIREMENTS

707.3.1 General

Installation includes erection of completed Standards, leveling of Standards, required grouting between Standard bases and foundations, and the installation of anchor bolts in foundations.

The Contractor shall retap and seal threaded holes and hubs with heavy grease or another type of preservative to prevent rust. The Contractor shall drill the required field-made holes (such as for mounting pedestrian push buttons) neatly. The Contractor shall not use a cutting torch.

If torque values are specified in the Contract for anchor bolt nuts, Breakaway couplings, or slip bolts, the Contractor shall make all adjustments with an approved torque wrench. The Contractor shall not use alternate torque values, unless approved by the Project Manager.

707.3.2 Galvanized Steel Standards

The Contractor shall repair scratches caused by erection and handling in the field with 95% zinc-rich paint.

707.3.3 Type II Standards Installation Requirements

The Contractor shall ensure that the length and position of arms are in accordance with the Contract. The Contractor shall attach the arms securely to the shafts.

707.3.4 Type V Standards Installation Requirements

The Contractor shall install davit arms in accordance with manufacturer's recommendations, to prevent rotation under wind loads. The Contractor shall drill the through holes for bolts in the top pole tenon in the field. If the arms rotate after erection, the Contractor shall lower the Type V Standard, reassemble the arm, and reinstall the Type V Standard with the arm in the proper position.

707.3.5 Type VI Standards Field Assembly

For a slip-fit design, the Contractor shall submit the proposed method for field assembly of Standard sections to the Project Manager for approval. The Contractor shall perform field assembly of the Standard sections and the assembly of the lowering device under the supervision of a representative of the manufacturer, trained, experienced in field assembly, and knowledgeable of the operation and construction of the Material supplied.

707.3.6 System Training

The Contractor shall provide a field representative to train the Department's personnel and local utility personnel, for one (1) Day, in the system's operation (lowering the devices, changing Luminaries, etc.). The Contractor shall submit the complete training program to the Project Manager and the State Traffic Technical Support Engineer for approval at least 15 Working Days before scheduling the system training. The Contractor shall include the following in the training:

1. Working outlines of presentations;
2. Specification manuals;
3. Video Recording;
4. Handouts; and
5. Other Materials to be distributed during the training.

707.3.7 New Foundations for Signal and Lighting Standards

The Contractor shall construct new foundations for signal and lighting Standards in accordance with Section 708, "Foundations for Signal and Lighting Installations."

707.3.8 Relocation of Existing Signal and Lighting Standards

The Contractor shall not remove existing signal and lighting Standards until placement of new foundations, Accepted by the Project Manager.

The Contractor shall notify the Project Manager, Traffic Services Signal Laboratory, and the Maintaining Agency at least five (5) Working Days before removing and resetting specified signal and lighting Standards. The Department will provide all shop drawings and other documents of record on the existing in-place signals and lighting Standards. The Contractor shall provide all Work and Materials required for rewiring relocated signals and lighting Standards, as included in this Work. The Contractor shall supply the new foundation for relocated existing signals and lighting Standards.

707.3.8.1 Removing and Resetting High-Mast Standard and Luminaire

When specified in the Contract, the Contractor shall construct new foundations for the existing Type VI Standards. The Contractor shall remove the existing Type VI Standards and the Luminaires and relocate the Standards and Luminaires to the new foundations.

707.3.8.2 Removing and Resetting Roadway Standard and Luminaire

When specified in the Contract, the Contractor shall construct new foundations for the existing Type V Standards. The Contractor shall remove the existing Standards and Luminaires and relocate the Standards and Luminaires to the new foundations.

707.3.8.3 Removing and Resetting Traffic Signal and Mast Arms

When specified in the Contract, the Contractor shall construct new foundations for the existing Type I, II, and III Standards. The Contractor shall remove the existing Type I, II, and III Standards, Traffic Signals, and mast arms. The Contractor shall relocate the Standards, Traffic Signals, and mast arms to the new foundations.

707.3.9 State-Furnished Standards, Mast Arms, and Roadway Luminaires

If specified in the Contract; the Contractor shall load, haul, and install State-furnished lighting Standards, mast arms, and Roadway Luminaires.

707.4 METHOD OF MEASUREMENT—Reserved

707.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Type ___ Standard, ___ ft</i>	Each
<i>Type ___ Standard, ___ ft Arm</i>	Each
<i>Remove and Reset High Mast Standard and Luminaire</i>	Each
<i>Remove and Reset Lighting Standard and Luminaire</i>	Each
<i>Remove and Reset Traffic Signal and Mast Arm</i>	Each
<i>Install State-Furnished Standards, Mast Arms, and Roadway Luminaires</i>	Each
<i>High Mast Lowering Device</i>	Each

The Department will pay for foundations in accordance with Section 708, "Foundations for Signal and Lighting Installations."

707.5.1 Work Included In Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Anchor bolts;
2. Hardware;
3. Protective coatings; and
4. Conductors for type V, and type VI Standards; and training and technical services for type VI Standards.

SECTION 708: FOUNDATIONS FOR SIGNAL AND LIGHTING INSTALLATIONS

708.1 DESCRIPTION

This Work consists of constructing reinforced concrete foundations for support of Traffic Signal Standards, Luminaire Standards, and control cabinets.

708.2 MATERIALS

708.2.1 Concrete

The Contractor shall use Class A concrete for Traffic Signal Standards (Type I) and control cabinet foundations in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall use Class G concrete for Traffic Signal Standards (Type II and III) and Luminaire Standards (Type V and VI) foundations in accordance with Section 502, "Drilled Shafts."

708.2.2 Steel Reinforcement

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

708.3 CONSTRUCTION REQUIREMENTS

708.3.1 General

The Contractor shall place foundations on firm ground. If the excavation conflicts with existing underground or overhead utilities, the Project Manager will determine a new location or provide a new foundation design or utility relocation. The Contractor shall restore the ground surface to its original elevation, if relocation is necessary. The Contractor shall construct foundations with final elevations no more than one (1) inch above the final pavement elevations or nearest top of curb elevation.

In Sidewalks, the Contractor shall provide flush top Standard foundations level with the surface of the Sidewalk and place expansion Material between the foundation and the Sidewalk.

708.3.1.1 Cast-In-Place Requirements

The Contractor shall securely brace rigid cast-in-place forms true to line and grade. Thoroughly moisten the forms and ground before placing concrete. The Contractor shall place the concrete for each foundation in one (1) operation.

After placement and before the concrete sets, raise and lower each anchor bolt to properly align, distribute concrete aggregate, and remove air voids. The Contractor shall give exposed surfaces of concrete foundations a smooth and straight finish, free of form marks.

708.3.2 Control Cabinet Foundations

The Contractor shall provide ground-mounted flush-top type control cabinet foundations eight (8) inches above finished grade or existing ground, unless otherwise specified in the Contract.

The Contractor shall properly locate and place cabinet anchor bolts during concrete

placement. The Contractor shall place a Class A concrete base pad in front of and behind control cabinet foundations. Construct the concrete pad in accordance with the Contract.

708.4 METHOD OF MEASUREMENT—Reserved

708.5 BASIS OF PAYMENT

The Department will pay for Traffic Signal Standards (Type II and III) and luminaire Standards foundations installations in accordance with Section 502, "Drilled Shafts."

The Department will pay for Structural Concrete, Class A used in foundations for signal and lighting installations in accordance with Section 511, "Concrete Structures."

The Department will pay for steel reinforcement used in foundations for signal and lighting installations in accordance with Section 540, "Steel Reinforcement."

708.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Excavation, backfill, compaction; and
2. Additional excavation, backfill, and encasing of existing utilities due to utility line conflict and foundation relocation.

SECTION 709: RIGID ELECTRICAL CONDUIT

709.1 DESCRIPTION

This Work consists of providing and installing rigid electrical conduit.

709.2 MATERIALS

709.2.1 Nonmetallic Conduit

Nonmetallic conduit shall be high-impact PVC. Schedule 40 conduit and elbows are manufactured to NMEA TC-2 UL 651 Specifications.

Conduit and fittings shall comply with requirements of UL Standards (Publication UL 651) and carry respective UL listings and labels.

709.2.2 Metallic Conduit

The Contractor shall provide galvanized rigid conduit in accordance with UL 6, ANSI C80 and Federal Specification WW-C-581E, or intermediate metallic conduit (IMC) in accordance with UL 1242 and Federal Specification WW-C-581E.

The Contractor shall hot-dip galvanize IMC. The Contractor shall provide watertight fittings of the same Material as the conduit.

The Contractor shall provide approved watertight, expansion couplings for metallic conduit, as recommended by the manufacturer and designed to compensate for linear thermal expansion of a run of metallic conduit.

709.2.3 Liquid-Tight Flexible Conduit

The Contractor shall provide liquid-tight flexible conduit consisting of an extruded polyvinyl jacket over a flexible hot-dipped galvanized core (Type UAG), UL listed, and in accordance with the NEC®.

709.3 CONSTRUCTION REQUIREMENTS

709.3.1 General

The Contractor shall run electrical cable and wire in conduit, except inside poles, unless otherwise specified in the Contract.

Where wire is not installed, a tracer wire must be installed for line locating.

When trenching, the Contractor shall place caution tape one (1) foot above the conduit.

The Contractor shall use nonmetallic conduit for underground installations. The Contractor shall use metallic conduit for Bridge decks and railings. The Contractor may encase conduit in concrete bases.

The Contractor shall use metallic conduit for above ground installations.

The Contractor may use larger size conduit than specified in the Contract, at no additional cost to the Department, provided the larger size is used for the entire run from outlet to outlet. The Department will not allow reducing couplings.

When using existing underground metallic conduit in a new system, the Contractor shall clean with a mandrel and blow out with compressed air. The Contractor shall blow out existing nonmetallic conduit with compressed air. If the existing conduit contains excessive amounts of Deleterious Material, the Contractor shall flush conduit with water and blow with compressed air, as directed by the Project Manager.

The Contractor shall provide pull boxes at the locations specified in the Contract.

709.3.1.1 Conduit Routings

The Project Manager may change conduit run routings specified in the Contract to avoid underground obstructions. The Contractor shall keep accurate records of any change from conduit locations specified in the Contract on as-built drawings, and submit the details to the Project Manager before the Department's final Acceptance of the Project.

709.3.1.2 Excavation and Backfill

The Contractor shall plan the trenching and conduit placement operation to minimize overnight open trenches and exposed conduit.

The Contractor shall excavate (trench) and backfill conduit trench in accordance with Section 705.2.2, "Backfill Materials," and Section 705.3.2, "Excavation and Backfill."

709.3.1.3 Conduit Placement Depth

The Contractor shall lay conduit at least 30 inches below the following:

1. Finished surface in Street and driveway areas;
2. Top of curb in Sidewalk areas; and
3. Natural ground line in unpaved areas. If approved by the Project Manager, the Contractor may place the conduit from 18 inch to 30 inch deep in the following areas:
 - a. Unpaved Median;
 - b. Open (natural ground) where the Department Plans no future development; and
 - c. Where underground utility conflicts occur at the 30 inch depth.

709.3.1.4 Conduit Terminations

The Contractor shall terminate, stub, and cap empty conduit. The Contractor shall thread metallic conduit ends and cap with standard conduit caps until wire placement begins. The Contractor shall provide insulated metal ground bushings for threaded ends when caps are removed and electrically connect them in accordance with the NEC®. The Contractor shall cap nonmetallic conduit ends until wiring begins.

The Contractor shall extend conduit terminating in poles, cabinets, or pedestal bases from two (2) inches to four (4) inches vertically above the bases.

The Contractor shall terminate conduit that enters a pull box from one (1) inch to three (3) inch inside the box wall and from two (2) inch to three (3) inch above the top of gravel sump and slope it to facilitate convenient pulling of wires or cables.

To ensure pull boxes are uncluttered, the Contractor shall run conduit into the pull box

bottom at the nearest wall. The Contractor shall allow for expansion and contraction of the conduit.

The Contractor shall install conduit terminations with bushings to prevent wire insulation damage during installation.

709.3.1.5 Conduit Bends

The Contractor shall make conduit bends, except factory bends, with a radius of at least six (6) times the inside diameter of the conduit. The Contractor shall ensure bending radii and the number of bends in accordance with the NEC® and local codes.

The Contractor shall use factory-made bends or bend conduit without crimping or flattening, using the longest radius practical.

The Contractor shall use metallic bends for difficult or long conduit runs.

709.3.2 Nonmetallic Conduit

The Contractor shall straight cut nonmetallic conduit; square and trim ends after cutting to remove rough edges. The Contractor shall use solvent weld connections in accordance with the conduit manufacturer's recommendations. If connecting nonmetallic conduit to metallic conduit, the Contractor shall use threaded couplings.

The Contractor shall run a solid, bare No. 8 or larger, AWG copper conductor continuously in nonmetallic conduit, except in conduit containing only communication cables.

The Contractor shall install expansion couplings according to the manufacturer's diagrams and instructions.

709.3.2.1 HDPE Conduit Extruded over Conductors

If allowed by local electrical codes for lighting and service run conduit, the Contractor may use HDPE conduit that is continually extruded over the wire or cable specified in the Contract. The Contractor shall prevent adhesion between the wire or cable and the conduit.

The Contractor shall obtain approval for this method from the electrical inspecting authority and provide proof to the Project Manager before installation.

709.3.2.2 Bending of Nonmetallic Conduit

The Contractor shall bend nonmetallic conduit using one (1) of the following methods:

1. Apply an even heat, not to exceed 300 °F, to a portion of the conduit wrapped in aluminum foil, until attaining the desired flexibility. Minimize charring of the conduit; and
2. Use of a thermobender, suitable for bending nonmetallic conduit.

709.3.3 Installation Under Existing Pavement

The Contractor shall install metallic conduit under existing pavement by approved jacking or boring methods.

If using drilling mud, the Contractor may install nonmetallic conduit by machine pulling through a directionally bored hole. The Contractor shall not machine pull nonmetallic conduit

through dry holes (made by hole hog or other dry-expansion methods). The Contractor shall place jacking or boring pits at least two (2) ft from the edge of any type of pavement, measured from the side of the pit nearest to the pavement. The Contractor shall only use metallic conduit, if jacking conduit.

The Department will not allow the excessive use of water in the installation of conduit under existing pavement.

The Project Manager may approve relocation of conduit runs or pavement cutting where insufficient room exists for jacking or boring pits, or if underground obstacles are encountered.

The Contractor shall repair existing pavement, Sidewalks, driveways and landscaped areas to original or better condition at no additional cost to the Department.

709.3.4 Conduit for Structures and Foundations

The Contractor shall cap conduit stubbed out for future use from Structures or foundations.

The Contractor shall rust-protect metallic conduit to a minimum of six (6) inches inside concrete Structures or foundations. The Department will not require rust protection for nonmetallic conduit.

The Contractor shall seal conduits running to soffits, walls, or light fixtures below the elevation of the pull box with an approved sealing compound. Also, the Contractor shall seal light fixtures located below the elevation of the pull box.

709.3.4.1 Bridge Structures

The Contractor shall use metallic conduit embedded in concrete for abutments, piers, or Bridge decks. The Contractor shall securely attach conduit to the reinforcing steel (by approved methods) at intervals not to exceed four (4) ft.

The Contractor shall use galvanized malleable iron clamps (or other approved methods) to secure conduit runs on Structure surfaces spaced no more than five (5) ft apart.

709.3.4.1.1 Expansion Fittings

The Contractor shall install expansion fittings where conduit crosses a Structure joint, using tubing the same size as the conduit. The Contractor shall provide expansion fittings with a bonding jumper of No. 6 AWG flexible wire or approved equivalent. If use of expansion fittings or flexible tubing is not feasible, as determined by the Project Manager, the Contractor shall install the conduit in a watertight metal sleeve. The Contractor shall ensure a clearance between the outside of the conduit and the inside of the metal sleeve of from 1/2 inch to one (1) inch.

709.3.4.1.2 Liquid-Tight Flexible Conduit

The Contractor may use liquid-tight flexible conduit between Structure sections to accommodate movement, if specified in the Contract. The Contractor may use liquid-tight flexible conduit within a concrete pour, if approved by the Project Manager.

709.4 METHOD OF MEASUREMENT

The Department will measure Rigid Electrical Conduit parallel to the centerline of the installed conduit.

709.5 BASIS OF PAYMENT

Pay Item

Rigid Electrical Conduit ____inch Dia.

Pay Unit

Foot

709.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Hardware for conduit installation,
2. Excavation, backfill, boring, jacking and compaction,
3. Protective coatings;
4. Bare No. 8 AWG copper conductor for nonmetallic conduit installation,
5. Caution tape; and
6. Cutting of pavement and replacement of surfacing.

SECTION 710: PULL BOXES AND SPLICE CABINETS

710.1 DESCRIPTION

This Work consists of providing and installing pull boxes and splice cabinets, and constructing Traffic Signal manholes.

710.2 MATERIALS

710.2.1 General

The Contractor shall provide electrical pull boxes for use in non-deliberate traffic areas, pull boxes and covers shall comply with all test provisions of ANSI/SCTE 77 2010 "Specification for Underground Enclosure Integrity."

The Contractor shall provide metal pull boxes for use in Bridge decks, railing, and other areas subject to deliberate vehicular traffic, provide enclosed watertight metal pull boxes that support, in place, an AASHTO H 20 loading (32,000 lb single axle over a 10 in x 20 in area), unless otherwise specified in the Contract.

710.2.2 Non-Deliberate Traffic Rated Polymer Concrete Pull Box

Non-deliberate traffic areas pull boxes shall be made of polymer coated concrete with fiberglass reinforcement. The box shall have continuous fiberglass cloth reinforcement on the inside and outside perimeter. The covers shall have a minimum of two (2) layers of fiberglass cloth reinforcement. Pull boxes shall comply with all test provisions of ANSI/SCTE 77 2010, "Specification for Underground Enclosure Integrity." All non-deliberate traffic pull boxes shall be tested and certified by UL 66WF (Underwriters Laboratories) or a nationally recognized third party independent test lab and re-verified every year to meet all test provisions of the ANSI/SCTE 77 2010 "Specifications for Underground Enclosure Integrity."

710.2.3 Deliberate Traffic Rated Pull Boxes

The Contractor shall provide metal pull boxes in accordance with the following:

1. Of closed-bottom type (external recess flanged), designed for flush mounting in concrete;
2. Designed for deliberate vehicular traffic (AASHTO H 20 loading); and
3. Fabricated from cast iron with a hot-dipped galvanized finish.

710.2.4 General Pull Box Cover Requirements

All pull box covers shall be designed for the required loadings and shall meet or exceed the rated loading of their corresponding pull box.

Pull box covers shall be sealed with a neoprene gasket providing a NEMA 4 water tight enclosure.

All non-deliberate traffic pull box covers shall comply with all test provisions of ANSI/SCTE 77 2010 "Specification for Underground Enclosure Integrity" and shall meet Tier 15 application. Markings showing the Tier 15 rating shall be embossed on the top surface of the cover.

All non-deliberate traffic pull boxes shall comply with all test provisions of ANSI/SCTE 77 2010 "Specification for Underground Enclosure Integrity" and shall meet the Tier 22

application. Markings showing the Tier 22 rating shall be labeled or stenciled on the inside and outside of the box.

All non-deliberate traffic pull boxes and covers shall be made of polymer coated concrete with fiberglass reinforcement. The box shall have continuous fiberglass cloth reinforcement on the inside and outside perimeter. The covers must have a minimum of two (2) layers of fiberglass cloth reinforcement.

All deliberate traffic rated pull boxes and covers must be made from matched metal tooling to ensure product uniformity.

All Covers must be secured to pull box using ½-13UNC S.S. penta head bolts.

Fasteners must be capable of withstanding a torque of 56 ft-lbs and a pull out strength of 750 lbs. The pull out test must be performed with the cover in place and fasteners torqued to 56 ft-lbs. Fasteners, inserts, and cover must not be damaged by the performance of this test.

Covers must have a non-skid surface with recessed lock-down locations for penta head bolts and pry bar slots.

The nominal dimensions of the opening in which the cover sits must be the same as the cover dimensions except the length and width dimensions must be 1/8" or greater.

The Contractor shall provide cast iron covers for concrete pull boxes where concrete pull boxes are specified in the Contract.

The Contractor shall fabricate No. 4 bare copper ground clamps to attach grounds to cast iron or steel covers where used on pull boxes without grounding provisions, unless otherwise specified in the Contract.

710.2.5 Pull Box Cover Inscriptions

The Contractor shall inscribe or emboss pull box covers with the words "TRAFFIC SIGNAL" or "LIGHTING," as specified in the Contract. The Contractor shall glue in logos shall not be permitted. On deliberate traffic rated pull boxes, the Contractor shall use a bead weld or other type of permanent lettering approved by the Project Manager to identify the specific circuit, as follows:

1. "Lighting" = Lighting and Rest Area Electrical;
2. Traffic Signal = "TS;" and
3. Sprinkler Control = "SC."

If using a bead weld on a galvanized box, the Contractor shall coat the affected area with zinc-rich paint.

710.2.6 Splice Cabinet

The Contractor shall provide a NEMA 12 enclosure UL listed "Industrial Control Panel" in accordance with UL 506.

710.2.7 Concrete and Reinforcing Steel

The Contractor shall provide Class A concrete, cement, air entrainment, admixtures, water, and aggregate in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall provide steel reinforcement in accordance with Section 540, "Steel Reinforcement."

710.2.8 Drainage Geotextiles

The Contractor shall provide Class B drainage geotextiles in accordance with Section 604, "Soil and Drainage Geotextiles."

710.2.9 Traffic Signal Manhole

710.2.9.1 Concrete Collar

The Contractor shall provide Class A concrete in accordance with Section 510, "Portland Cement Concrete."

710.2.9.2 Steel Culvert Pipe

The Contractor shall provide corrugated metal pipe Culvert in accordance with Section 570, "Pipe Culverts."

The Contractor shall dip steel Culvert pipe in coal tar enamel or coat with polymeric coating approved by the Project Manager. The Contractor shall provide a three (3) mil thick coating in accordance with AASHTO M 246.

710.2.9.3 Manhole Covers

The Contractor shall provide Traffic Signal manhole covers in accordance with Section 662, "Manholes."

710.3 CONSTRUCTION REQUIREMENTS

710.3.1 General

The Contractor shall install each pull box flush with the curb or Sidewalk grade with no part of the box or attaching screws protruding above the surface. If no grade is specified, the Contractor shall place pull boxes slightly higher than the surrounding ground to provide drainage away from the pull box. Pull boxes should not be installed within the ADA ramp area.

The Contractor shall install metal pull boxes in Bridge decks and pavement flush with the pavement surface.

The Contractor shall install electrical pull box extensions to provide additional volume, as necessary or as specified in the Contract.

If necessary to facilitate the Work (for the Contractor convenience), the Contractor shall install more pull boxes than shown in the Contract at no additional cost to the Department.

The Contractor shall provide each pull box with a Class A concrete collar placed around the pull box, separated by a 1/2 inch felt expansion joint. If placing concrete collar in an area to receive colored concrete, the Contractor shall match the pull box concrete color with the colored concrete.

710.3.2 Deliberate Traffic Rated Pull Boxes

The Contractor shall make conduit entrances in metal pull boxes with a hole saw, or as

approved by the Project Manager.

710.3.3 Pull Box Sumps

The Contractor shall provide sumps in pull boxes consisting of two (2) inch maximum size rock fill, surrounded by drainage geotextile.

With the exception of metal pull boxes installed in concrete, the Contractor shall provide an 18 inch deep sump below pull boxes. If using pull box extensions with pull boxes to provide extra depth, make sumps 30 inches deep.

Excavate holes to allow a minimum six (6) inch clearance on the sides of the boxes and extensions. The Contractor shall provide rock fill around outside walls. The Contractor shall place Class B drainage geotextile between the backfill and rock fill.

710.3.4 Traffic Signal Manhole

The Contractor shall install each Traffic Signal manhole so that the cover is flush with the curb or Sidewalk grade and no part of the manhole protrudes above finish grade. If the Contract does not specify a grade, the Contractor shall place covers slightly higher than the surrounding ground to provide drainage away from the manhole.

710.4 METHOD OF MEASUREMENT—Reserved

710.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Electrical Pull Box (Standard)</i>	Each
<i>Electrical Pull Box (Large)</i>	Each
<i>Electrical Pull Box Extension</i>	Each
<i>Metal Pull Box</i>	Each
<i>Splice Cabinet</i>	Each
<i>Traffic Signal Manholes</i>	Each

710.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Hardware;
2. Excavation, backfill, and compaction;
3. Reinforcing steel;
4. Concrete; and
5. Materials for pull box and Traffic Signal manhole sumps.

SECTION 711: WIRING

711.1 DESCRIPTION

This Work consists of providing and installing wiring for Traffic Signal and Highway lighting systems.

711.2 MATERIALS

711.2.1 General

The Contractor shall provide wire and cable in accordance with the appropriate sections of the International Municipal Signal Association's (IMSA) *Wire and Cable Specifications* and the New Mexico Electrical Code (14.10.4 NMAC) and that carries the UL label. The Contractor shall use copper or aluminum conductors of the specified trade size.

711.2.2 Multi-Conductor

The Contractor shall provide polyethylene insulated, PVC or polyethylene jacketed, solid wire signal cable multi-conductors in accordance with IMSA Specification 19-1 or 20-1. The Contractor shall provide special multi-conductor cable for direct burial or self-supporting applications, as specified in the Contract.

The Contractor shall provide color code conductors in accordance with IMSA Specification 19-1 or 20-1, Section 5.1 Table II for unpaired conductor cables. The Contractor shall provide No. 14 AWG size copper conductors, or conductors as specified in the Contract.

The Contractor shall provide molten dyed polyethylene tracer color co-extruded with the base color.

711.2.3 Single Conductor

The Contractor shall provide moisture and heat-resistant thermoplastic insulated electrical cable for single conductors rated at 600 V for installation in conduit and pipe.

The Contractor shall provide No. 12 AWG size or smaller solid copper conductors in accordance with ASTM B 3. The Contractor shall use uncoated wire unless otherwise specified. The Contractor shall provide No. 10 AWG size or larger stranded conductors in accordance with ASTM B 8, Class B. The Contractor shall provide solid No. 8 AWG minimum for ground wires.

When designated in the Contract, the Contractor shall provide No. 10 AWG size or smaller solid aluminum conductors in accordance with ASTM B 3. The Contractor shall use uncoated wire unless otherwise specified. The Contractor shall provide No. 8 AWG size or larger stranded conductors in accordance with ASTM B 8, Class B. The Contractor shall provide solid No. 6 AWG minimum for ground wires. Aluminum wiring shall only be used for lighting installations.

711.2.3.1 Insulation

711.2.3.1.1 Compound

The Contractor shall provide thermoplastic high heat resistant nylon coated (THHN) or thermoplastic heat and water resistant nylon coated conductors in accordance with UL 83 for copper conductors.

The Contractor shall provide thermoplastic high heat resistant nylon coated (THHN) or thermoplastic heat and water resistant nylon coated conductors in accordance with UL 486B for aluminum conductors. The Contractor shall ensure that insulation thickness for aluminum conductors is in accordance with ASTM D 2220 and NEC®, Table 310-13. The Contractor shall provide conductors factory tested to ensure compliance with UL 486B.

The Contractor shall provide conductors with distinctive, permanent markings on the outer surface for the entire length showing manufacturer, type of insulation, size of conductor, and voltage rating. The Contractor shall provide solid color or basic colored insulation with a permanent colored stripe the entire length of the conductor.

711.2.3.1.2 Thickness

The Contractor shall ensure that insulation thickness is in accordance with ASTM D 2220 and NEC®, Table 310-13.

711.2.3.1.3 Testing

The Contractor shall provide copper conductors factory tested to ensure compliance with UL 83. The Contractor shall provide aluminum conductors factory tested to ensure compliance with UL 486B.

711.2.3.1.4 Identification

The Contractor shall provide conductors with distinctive, permanent markings on the outer surface for the entire length showing manufacturer, type of insulation, size of conductor, and voltage rating. The Contractor shall provide solid color or basic colored insulation with a permanent colored stripe the entire length of the conductor.

711.2.4 Communication Cable

The Contractor shall provide a paired polyethylene-insulated, polyethylene-jacket communication cable with electrical shielding, rated 300 V, in accordance with IMSA Specification No. 40-2-1990 (or Rural Electrification Administration specification PE-22 or PE-39), suitable for use in underground conduit. The Contractor shall Provide a conductor of No. 19 AWG copper, unless otherwise specified.

711.2.5 Ground Rods

The Contractor shall provide ground rods from hard-drawn, high-conductivity electrolytic copper fluted rods, or bare, round, hard-drawn copper-covered steel rods per NEC®.

711.3 CONSTRUCTION REQUIREMENTS

711.3.1 General

The Contractor shall install wire in accordance with the NEC®, state, and local requirements. The Contractor shall neatly arrange and lace wiring within cabinets, pull boxes, and pole bases.

The Contractor may use cable pulling lubricant for inserting conductors into conduit. The Contractor shall install bushings on metallic conduit ends before pulling wire.

For each conductor or cable, the Contractor shall leave a minimum of four (4) ft of slack

at each signal or lighting Standard and a minimum of two (2) ft of slack at each pull box.

The Contractor shall wire nut ends of spare conductors.

711.3.2 Identification

The Contractor shall identify the phase or function of signal cable conductors with the insulation colors specified in the Contract and the following:

1. Black insulation for lighting circuit and signal service conductors;
2. Black or red insulation for two (2) ungrounded multiple lighting circuits; and
3. White insulation for neutral and common wiring.

The Contractor shall install identification tags at cabinet, pull box, and pole locations where two (2) or more conductors or cables for different functions have the same insulation colors. The Contractor shall use permanent fiber or PVC tags for tagging wires.

The Contractor shall place the low-voltage circuits for pedestrian push buttons in a separate multi-conductor cable from 115-V function conductors, and identify all conductors at each splice point.

711.3.3 Terminals

The Contractor shall secure cable wires to screw-type terminals in Traffic Signal heads, pedestrian push buttons, and traffic controllers using spades or as specified in the Contract. Spade tongue-type connectors shall be affixed to conductors using a pigtail connector or a tool specifically designed for connecting connectors to conductors.

711.3.4 Splices

The Contractor may use conductor splices for Traffic Signals only inside cabinets and transformer bases with wiring access. The Contractor shall not use splices in pull boxes. The Contractor may use conductor splices for lighting installations inside cabinets, transformer bases, or pull boxes.

The Contractor shall make wiring connections at the appropriate terminals. The Contractor shall loop detector wire or video camera power and data cables as specified by the manufacturer. The Contractor shall not splice suspended cable used on permanent span wire installations.

The Contractor shall not use soldered connections for splicing, except for connection of loop lead in cable to loop detector wire. The Contractor shall weatherproof the entire splice. The Contractor shall wrap splices with all-weather plastic electrical recording. The Contractor shall tape recording cable ends to exclude moisture while pulling cables into conduit. The Contractor shall keep ends recording until completing splices or attaching terminal appliances.

The Contractor shall use communication cables for signal interconnect systems, with splicing at terminals or as specified in the Contract. The Department will not allow other splicing. For signal installations, the Contractor shall use only spring-type connectors for splicing 600 V conductors. For lighting installations, the Contractor shall make underground splices waterproof, using an NEC® approved method.

711.3.4.1 Spring-Type Connector

The Contractor shall join the wire ends with an insulated spring-type connector without

soldering. The Contractor shall provide a two (2)-component, self-curing epoxy resin in a double-compartment plastic envelope. To make the splice insulation, the Contractor shall thoroughly mix the components in the envelope and, after cutting open one (1) end of the envelope, insert the wire connection into the epoxy resin and recording the envelope shut. The Contractor shall provide sufficient epoxy resin to completely cover the connector and exposed bare wires at the connector.

711.3.4.2 Fused Splice Connector

The Contractor shall install a fused disconnect splice connector of the "Breakaway" type at each ungrounded conductor in Type IV and V Standard bases between the line and load sides on multiple lighting circuits. The Contractor shall provide an integral un-fused connection in the connector, providing similar and simultaneous disconnect between the load and line sides on the neutral, if a neutral is used. The Contractor may use fused splice connectors with either single or dual housings. The Contractor shall make connectors readily accessible from the Standard base hand hole.

The Contractor shall provide a fully self-insulated and waterproof splice connector. The Contractor shall provide line and load side housings of an elastomeric Material capable of meeting the *Impact and Dielectric Voltage Withstand Test*, in accordance with UL 486D, for an assembled connector. The Contractor shall integrally mold line and load side housings with cable sealing boots providing a defined series of cylindrical bores to receive and provide a waterproof seal on appropriately sized insulated conductors. The Contractor shall not use recordings or other sealing compounds.

The Contractor shall design fused-splice connectors to disconnect at a maximum tension of 35 lb, for each conductor attached to the load side. The Contractor shall ensure that the fuse(s) or neutral pin contact is securely retained on the load side when disconnected. The Contractor shall provide line-side housings with a thickness of at least 1 1/4 inch.

The Contractor shall use in-line type Buchanan 65/D65 fused splice connectors, or an approved equal, with fuse housings for all phase/phase type connections requiring one (1) or two (2) fuses. The Contractor shall use polarized dual connectors (D65 or equivalent) that provide simultaneous disconnect of both phases, assuring no exposure to energized electrical contacts.

The Contractor shall use 20/D65 PN connectors, or an approved equal, for circuit designs of the phase/neutral type connection. The Contractor shall provide polarized dual connectors (D65PN or equal) with two (2) compartments. The Contractor shall fit one (1) compartment with fuse contacts and the opposite compartment with a solid neutral pin contact. The Contractor shall fit the neutral side with a white marker to indicate the neutral side.

The Contractor shall rigidly crimp splice connector terminals onto line and load connectors using a tool recommended by the connector manufacturer. The Contractor shall insulate and waterproof terminals in accordance with the connector manufacturer's recommendations.

The Contractor shall use Standard midget ferrule type fuses. The Contractor shall use 10 A fuses for 240 W or 400 W lamps.

711.3.4.3 Tap Splices

The Contractor shall make tap splices in pole bases are to be as specified by the service utility provider.

The Contractor shall splice each circuit conductor in the pole base, inserting the feeder conductor and the continuing run conductor into the double end boot of the connector and securing each into the respective set screw terminal. The Contractor shall use No. 10 AWG Copper, Type thermoplastic heat and water resistant insulated wire, rubberized heat and water resistant insulated wire, or approved equal insulation, for the tap conductor feeding the fused splice connector. The Contractor shall not use THHN-type insulation.

The Contractor shall feed the tap conductor through the tap boot (as specified in the manufacturer's instructions) and attach under the center set screw.

The Contractor shall mark neutral conductors with white marking recording.

711.3.5 Bonding and Grounding

The Contractor shall mechanically and electrically secure metallic cable sheaths, metal conduit service Equipment, and metal poles and pedestals to form a continuous system. The Contractor shall effectively ground the system. The Contractor shall bond with copper wire or copper strip of at least the same cross sectional area as No. 8 AWG. The Contractor shall use solid No. 8 AWG at minimum for grounding jumpers.

The Contractor shall use a bonding strip attached to the lower portion of the shaft or base to bond Standards and pedestals.

For nonmetallic conduit systems, the Contractor shall run a bare copper wire of No. 8 AWG or larger through conduit runs, pull boxes, and to poles. The Contractor shall splice these wires at termination points and tie into neutral bars at service facilities or control cabinets.

The Contractor shall install a ground rod (electrode) at each multiple service point, each Traffic Signal Standard, each cabinet foundation, and each Luminaire foundation. The Contractor shall provide 3/4 inch nominal diameter ground rods. The Contractor shall install so that at least 7.5 ft of the ground rod length is in contact with the soil and in accordance with NEC® Specifications. The Contractor shall bond service Equipment to the ground rod by a No. 6 AWG copper wire.

Where encasing portions of ground rods in concrete, the Contractor shall wrap with three (3) layers of pipe insulation recording, 0.01 inch minimum thickness, or place through a one (1) inch diameter PVC conduit.

Where a metallic conduit system parallels or crosses a permanent water system in accessible areas, the Contractor shall install grounding jumpers at intervals not exceeding 500 ft. The Department will not allow grounding to a metallic water system at or near a service point, in lieu of driven ground rods. The Contractor shall use insulated grounding bushings and bonding jumpers to bond metallic conduit in nonmetallic pull boxes. The Contractor shall use lock nuts to bond metallic conduit in metal pull boxes. The Contractor shall use one (1) lock nut inside and one (1) lock nut outside of each box when the box is not threaded.

711.4 METHOD OF MEASUREMENT—Reserved

711.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Multi-Conductor Cable</i> ____ (number)	Foot
<i>Single Conductor</i> ____ (AWG number), ____ (Material)	Foot

711.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Splice connectors;
2. Ground rods and grounding conductors;
3. Hardware;
4. Weatherproofing; and
5. Recording.

SECTION 712: SIGNAL ASSEMBLIES

712.1 DESCRIPTION

This Work consists of providing and installing traffic and pedestrian signal assemblies on signal poles and attaching base plates and directional louvers to Traffic Signals.

712.2 MATERIALS

712.2.1 Traffic Signal Assembly

The Contractor shall provide standard 12 inch lens size signal faces.

The Contractor shall ensure that signal assemblies meet the requirements of the latest edition of ITE Publication, *Adjustable Face Vehicular Traffic Control Signal Heads*. The Contractor shall provide adjustable, colored light, vertical or horizontal type signal assemblies with the number and type of lights (faces) specified in the Contract. The Contractor shall ensure that the signal assemblies adjust 360° about a vertical axis.

The Contractor shall fabricate signal assemblies, housings, and doors of polycarbonate resin Material. If using polycarbonate resin Material, the Contractor shall ensure its capability to withstand an impact of 70 lb per foot without fracture or permanent deformation.

The Contractor shall design signal assemblies to accept mounted back plates.

712.2.1.2 Housing

Signal housing consists of an assembly of separate sections without tie rods, substantially secured in a watertight manner to form the number of units required. Each section houses an individual optical unit.

The Contractor shall provide a one (1)-piece housing for each section made of a polycarbonate resin Material with sides, top, and bottom integrally molded. The Contractor shall ensure ribbed polycarbonate housings have at least a minimum thickness of 0.09 inch. The Contractor shall ensure that the housing passes the ITE wind-load testing.

The Contractor shall include a one (1)-piece hinged door in each section with mounting LED, watertight gaskets, and a simple corrosion-resistance door-locking device. The Contractor shall mount the LED so that its parts are readily accessible or removable. The Contractor shall provide interchangeable sections constructed for easy removal or addition. The Contractor shall provide a round opening in the top and bottom of each head for a 1 1/2 inch supporting pipe frame.

The Contractor shall hinge each door and secure to the body of the housing with two (2) stainless steel hinge pins, eyebolt, washer, and wing nut. The Contractor shall use corrosion-resistance screws and fasteners, where exposed to the elements. The Contractor shall make interior screws and fasteners from zinc-plated brass.

The Contractor shall integrally cast or mold a locking boss with 72 teeth into the signal housing at both openings. The Contractor shall make the angle of the teeth 90° and the depth of the teeth 0.0468 inch. The Contractor shall ensure that the locking boss provides positive positioning of the entire signal head to eliminate rotation or misalignment.

The Contractor shall mount a terminal block in the back of the middle section of the Signal Assembly. At a minimum, the Contractor shall provide a five-position, terminal block for

signal assemblies. The Contractor shall attach the signal section leads to the left of each terminal block and leave the opposite terminals for the field wires.

The Contractor shall provide two (2) coded leads with NEMA quick-disconnect tabs for wiring from each LED. The Contractor shall connect a white wire to the shell of the LED and a black or colored wire to the bottom or end terminal of the LED. For identification, the Contractor shall color-code leads with the appropriate red, yellow, or green, (yellow or green tracer for arrow indications). If using black wires, the Contractor shall permanently mark the terminals to identify the leads where they attach. The Contractor shall provide No. 18 AWG size, Type TFF leads.

712.2.1.3 Visors

The Contractor shall provide each signal section with a 12 inch nominal length tunnel visor of 3003-H16 corrosion-resistant aluminum alloy sheet a minimum of 0.04 inch thick in accordance with ASTM B 209. The Contractor shall encircle the lens with tunnel visors for 300° with a four (4) inch open slot on the bottom. The Contractor shall provide the visor with four (4) twist-on attaching ears for installation to the signal door by four (4) corrosion-resistant screws. The Contractor shall provide the vertical outer face of the door with four (4) threaded holes equally spaced around the circumference of the lens opening and 45° from the horizontal or vertical axis, to allow vertical or horizontal installation of the Signal Assembly.

712.2.1.4 Framework and Mounting Brackets

The Contractor shall provide mounting brackets consisting of assemblies of 1 1/2 inch nominal size Standard steel pipe and malleable iron, ductile iron, or brass pipe fittings. The Contractor shall securely assemble members to provide plumb or level support.

712.2.1.5 Finish

When making the Signal Assembly of polycarbonate resin Material, the Contractor shall completely impregnate the required color into the resin Material. The Contractor shall not allow scratches that expose uncolored Material.

The Contractor shall finish the visor and the outside surfaces of framework and mounting brackets with two (2) coats of best-quality infrared oven-baked paint as follows:

1. Signal housing and door inside and out:
 - 1.1. Signal housing—federal yellow;
 - 1.2. Signal door—flat black;
2. Visor inside and out:
 - 2.1. First coat—baked epon primer, zinc chromate, or equal;
 - 2.2. Second coat—flat black urea baked enamel having zero (0) glass reflectance. Minimum dry film thickness of 0.001 inch; and
3. Use special finishes for special applications and as specified in the Contract.

712.2.1.6 Geometrically Programmed Louver

712.2.1.6.1 General

The Contractor shall provide a louver with the following features:

1. Fit all manufacturers' 12 inch signal visors;
2. Retrofit into existing 12 inch signal visors;

3. Provide a full round ball display, with minimum slat effect, throughout the selected view range;
4. Provide an absolute exact visual cut-off;
5. Allow the view angle within each signal section to be adjusted to a designated area;
6. Have a minimum glow outside the view range;
7. Allow for controlling either the horizontal or vertical view range within the signal visor;
8. Lightweight (Not to exceed five (5) lbs); and
9. Maintenance free.

712.2.1.6.2 Housing

The housing design shall allow the baffle positions to be changed in order to adjust the view angle.

712.2.1.6.3 Baffles

The Contractor shall provide baffles identical in design and interchangeable within the housing.

The plane of each baffle shall be 90° to the centerline axis in the housing.

712.2.1.6.4 Attaching Hardware

The Contractor shall provide six (6) black, self-threading screws with each louver assembly for attaching the louver to the signal section.

712.2.1.6.5 Installation Kit

The Contractor shall provide an installation kit suitable to be utilized as an aid in installing the louver assembly.

712.2.1.7 Traffic Signal Assembly (LED)

712.2.1.8 Optical Units

The Contractor shall design light emitting diode signal modules that do not require special tools for installation as retrofit replacements for optical units of Standard Traffic Signal sections. Light emitting diode signal modules must fit into the existing Traffic Signal section housings, built in accordance with the requirements in the ITE publication ST-008B, *Vehicle Traffic Control Signal Heads (VTCSH)* without modification.

The Contractor shall use terminal block connections in the signal face. Splices will not be allowed.

The Contractor shall integrate the lens of the light emitting diode signal module with the unit. The Contractor shall fabricate the convex lens, with a smooth outer surface, from ultraviolet stabilized plastic or glass. The lens is required a minimum exposure of 48 months to direct sunlight (ultraviolet) without deterioration.

If a polymeric lens is used, the Contractor shall use a surface coating or chemical surface treatment to provide front surface abrasion resistance.

The operating temperatures range for light emitting diode signal modules are from -104 °F to 165 °F.

The Contractor shall protect light emitting diode signal modules against dust and moisture intrusion in accordance with the requirements in NEMA Standard 250-1991 for Type 4 enclosures.

The Contractor shall use a single, self-contained light emitting diode signal module not requiring onsite assembly for installation into existing Traffic Signal housing. The Contractor shall integrate the power supply for the light emitting diode signal module into the unit.

The Contractor shall manufacture the light emitting diode signal module assembly to withstand mechanical shock and vibration.

The Contractor shall conform the minimum initial luminous intensity values for light emitting diode signal modules to the requirements in Section 11.04 of the *VTCSH* at 77 °F.

The Contractor shall provide light emitting diode signal modules that after 48 months of continuous use over the temperature ranging from -104 °F to 165 °F are at least 85 percent of the Standard light output values specified in the *VTCSH*.

The Contractor shall ensure that the measured chromaticity coordinates of light emitting diode signal modules are in accordance with Section 8.04 and Figure 1 of the *VTCSH* over the temperature ranging from -104 °F to 165 °F.

The Contractor shall take luminous intensity measurements over the temperature ranging from -104 °F to 165 °F.

The Contractor shall measure color requirements while operating throughout the temperature ranging from -104 °F to 165 °F.

The Contractor shall operate light emitting diode signal modules over a voltage range from 120 V AC: 80 V to 135 V, 240 V AC: 184 V to 276 V, 12 V DC: 8 V to 24 V at a frequency of 60 Hz ± 3 Hz. The Contractor shall prevent perceptible flicker over the specified voltage range using the light emitting diode circuitry. Voltage fluctuations shall have no visible effect on the luminous intensity of the indications.

The Contractor shall use wiring and terminal blocks conforming to the requirements in Section 13.02 of the *VTCSH*. The Contractor shall provide two (2) secured, color coded jacketed wires (600 V, 20 AWG minimum), in accordance with the NEC®, rated for service at least 221 °F for electrical connection for each light emitting diode signal module.

The Contractor shall include voltage surge protection to withstand high-repetition noise transients in accordance with Section 2.1.6 of NEMA Standard TS2-1992 for the light emitting diode signal module on-board circuitry.

The Contractor shall ensure that light emitting diode signal modules are operationally compatible with currently used controller assemblies (solid state load switches, flashers, and conflict monitors).

The Contractor shall provide and install light emitting diode signal modules and associated onboard circuitry in accordance with Federal Communications Commission (FCC) regulations concerning the emission of electronic noise (47 C.F.R. § 15.101 et seq.).

The Contractor shall provide a power factor of at least 0.90 while operating light emitting

diode signal modules throughout the temperature ranging from -104 °F to 165 °F.

The Contractor shall ensure that light emitting diode signal modules are compatible with the controller unit, conflict monitor, and load switch.

712.2.2 Reserved

712.2.3 Reserved

712.2.4 Pedestrian Signal (LED)

The Contractor shall design light emitting diode pedestrian signal modules that do not require special tools for installation as retrofit replacements for optical units of Standard pedestrian signal sections. Light emitting diode signal modules must fit into the existing pedestrian signal section housings built in accordance with the requirements in the VTCSH without modification.

The LED signal module consists of a double side-by-side message combining the symbols of a hand/walking person and countdown display. The Contractor shall arrange the LEDs in a manner to form an outline of the symbols. The shape of the outline must conform to the standard symbols for pedestrian signals.

The Contractor shall ensure that the measured chromaticity coordinates for the "lunar white" walking person and the "portland orange" countdown/hand are in accordance with the VTCSH. The Contractor shall ensure that the chromaticity measurements remain unchanged over the input line voltage range from 120 V AC: 80 V to 135 V, 240 V AC: 184 V to 276 V, 12 V DC: 8 V to 24 V.

The Contractor shall distribute the LEDs evenly along the message outline. The Contractor shall not vary the distance between each LED more than ten percent (10%). The Contractor shall ensure that the hand or walking man symbols are at least (H×W) ten (10) inch × 6.5 inch. The Contractor shall ensure that the countdown display is at least six (6) inches high and on black opaque background. The Contractor shall interconnect the individual LED light sources to minimize the loss of no more than three (3) LEDs or five percent (5%) of the signal light output when a catastrophic failure of single LED occurs. The display face consists solely of LEDs mounted on a black printed circuit board mat.

The Contractor shall provide an LED signal module that is rated for use in operating temperature ranging from -104 °F to 165 °F. The Contractor shall completely seal the LED module against dust and moisture intrusion in accordance with NEMA Standard 250-1991 Section 4.7.2.1 and Section 4.7.3.2 for Type 4 enclosures.

The Contractor shall use a single, self-contained LED signal module device not requiring onsite assembly for installation into existing Traffic Signal housing. The Contractor shall manufacture the LED signal module assembly to withstand mechanical shock and vibration from high winds and other sources.

The Contractor shall not exceed the maximum rating for DC current recommended by the LED manufacturer used by the driver board to drive the LEDs. The Contractor shall use the driver board to regulate the LED drive current on both the hand and walking man messages to compensate for line voltage fluctuations over the range of 120 V AC: 80 V to 135 V, 240 V AC: 184 V to 276 V. The Contractor shall ensure that the luminous output does not vary more than ten percent (10%) over the voltage range and that it is not perceptible to the human eye. The Contractor shall use drive circuitry that includes voltage surge protection to withstand high-repetition noise transients and low-repetition high-energy transients in

accordance with Section 2.1.6, NEMA Standards TS-2, 1992. The Contractor shall provide onboard circuitry in accordance with FCC regulations concerning the emission of electronic noise (47 C.F.R. § 15.101 et seq.). The Contractor shall ensure compatibility in the circuitry, proper triggering and operation of the load switches, and conflict monitors in signal controllers currently in use by the procuring traffic authority.

712.2.5 Back Plates

The Contractor shall provide back plates as follows:

1. For signal faces with vehicular signal indications, if specified in the Contract;
2. Of one (1)-piece aluminum;
3. Of a size that provides a five (5) inch border around the perimeter of the signal; and
4. Louvered aluminum.

712.2.6 Directional Louvers

Actual louver angles to be provided in the Contract.

712.3 CONSTRUCTION REQUIREMENTS

The Contractor shall cover vehicular Signal Assembly faces after installation until the controller and intersection signals are put into operation. The Contractor shall ensure that the covering does not permit any misunderstanding by the general public that the signal is in operation.

The Contractor shall make signal faces plumb and adjust them to proper direction. The Contractor shall make faces and frameworks plumb and level, symmetrically arranged, and secure after alignment.

The Contractor shall mount overhead mast arm-mounted Traffic Signal assemblies horizontally, unless the Contract specifies mounting an overhead Signal Assembly vertically to a mast arm or span wire.

The Contractor shall install back plates and directional louvers on signal assemblies in accordance with the recommendation of the manufacturer.

712.3.1 Warranties and Maintenance

The Contractor shall:

1. Obtain and assign to the Department all manufacturer's and producer's guarantees or warranties for items and Materials incorporated into the Work. If the manufacturer's or producer's guarantee is absent, a guarantee from the Contractor is necessary for six (6) months after Acceptance by the Department. Include the following in this guarantee:
 - 1.1 Mechanical and electrical Equipment and Material incorporated into the Work are free from any defects or imperfections;
 - 1.2 Repair of any malfunction or defect in any such Equipment or Material, which develops is at no additional cost to the Department;
2. Supply installation guides and user manuals to the Department for the Equipment incorporated in the Project; and
3. Provide the Department with a Certificate of Compliance from the manufacturer in accordance with the requirements in these Specifications. Include a copy of

applicable test reports on the light emitting diode signal and pedestrian modules in the certificate.

712.4 METHOD OF MEASUREMENT

The Department will measure signal assemblies, pedestrian signals, pedestrian countdown signals, back plates, directional louvers, and pedestrian sound units by the number of sections required and by type specified (if applicable).

712.5 BASIS OF PAYMENT

Pay Item	Pay Unit
____(number) Section Traffic Signal Assembly	Each
____(number) Section Optically Programmed Signal Assembly	Each
____(number) Section Back plate	Each
Directional Louver	Each
Pedestrian Sound Unit	Each
____(number) Section Traffic Signal Assembly (LED)	Each
Pedestrian Signal (LED)	Each

712.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. All Materials required for a complete installation, including hardware and lamps.

SECTION 713: DETECTORS

713.1 DESCRIPTION

713.1.1 Vehicle Detection System

This Work shall consist of furnishing and installing a Vehicle Detection System that detects vehicles on a Roadway via processing of images and/or objects and provides detector outputs to a traffic controller.

713.1.2 Emergency Vehicle Optical Detector System

This Work consists of providing and installing an emergency vehicle optical detector (EVOD) or GPS systems at signalized intersections, using optical communication to identify the presence of priority vehicles and instruct the Traffic Signal controller to find and hold a desired Traffic Signal display.

713.1.3 Vehicle and Pedestrian Detectors

This Work consists of providing and installing vehicle detectors in Roadways and pedestrian push buttons on signal Standards.

713.1.4 Accessible Pedestrian Signal (APS)

Accessible Pedestrian Signal, or APS means a Pushbutton-Integrated device that communicates information about Pedestrian Timing in a non-visual manner, such as audible tones, speech messages, and vibrating surfaces, and has the following features to the extent that they are available from an APS manufacturer:

1. A Pushbutton Locator Tone;
2. A Pushbutton Actuation Tone and light in response to the button push to indicate that the button has been pressed;
3. An Audible Walk Indication;
4. A Vibrotactile Walk Indication;
5. Automatic volume adjustment in response to ambient sound;
6. A tactile arrow;
7. A Pushbutton Information Message; and
8. A Pushbutton with a two (2) inch minimum diameter.

713.1.4.1 Definitions

Audible Beaconing. The use of a permanently fixed sound source to provide directional orientation and crossing alignment information to pedestrians with visual impairments or blindness.

Audible Walk Indication. An audible method of indicating the Walk Interval, either through a Rapid Tick or Speech Message. When a Speech Message is the Audible Walk Indication, it shall follow the following model: “[Street name]. Walk sign is on to cross [Street Name].”

Control Surface. The vertical surface on which the pushbutton is located.

Intersection. A location with one (1) or more pedestrian crosswalks; including mid-block crossings, and with one (1) or more Visual Pedestrian Signals associated with the crosswalks.

Pedestrian Change Interval. The portion of the Pedestrian Timing during which the flashing upraised hand, symbolizing “Don’t Walk,” is displayed and countdown has begun, signaling that pedestrians should finish crossing the street.

Pedestrian Timing. The cycle of the time allotted in the signal cycle to allow a pedestrian to cross the street. Pedestrian Timing consists of: (i) the Walk Interval and (ii) the Pedestrian Change Interval.

Pushbutton Information Message. The information delivered audibly when the pushbutton is pressed and held for one (1) second or more during the flashing or steady “Don’t Walk” indicator and during the countdown. The Pushbutton Information Message shall follow the model “Wait to cross [Street name] at [cross street name].” Information on unusual intersection signalization or geometry may be provided following the crosswalk identification message. No other types of information may be provided.

Pushbutton-Integrated Accessible Pedestrian Signal. An Accessible Pedestrian Signal in which all audible and vibrotactile information is provided from the pushbutton housing. The Pushbutton-Integrated APS may also activate an overhead speaker where Audible Beaconing is provided, as set forth in section below.

Pushbutton Locator Tone. A repeating sound that informs approaching pedestrians of the APS. Pushbutton Locator Tones shall be easily locatable, shall have duration of 0.15 seconds or less, and shall repeat at one-second intervals while the visual flashing and steady “Don’t Walk” message appears on the Visual Pedestrian Signal.

Rapid Tick. A ticking sound that repeats at the rate of ten (10) ticks per second.

Speech Message. A spoken instruction that provides information to the pedestrian with visual impairments or blindness about the street crossing location and Walk Interval. When a Speech Message is the Audible Walk Indication, it shall follow the following model: “[Street Name]. Walk sign is on to cross [Street Name].”

Vibrotactile Walk Indication. A tactile arrow that contrasts with the background, is oriented in the direction of travel on the associated crosswalk, and vibrates throughout the Walk Interval, indicating that the Walk Interval is on.

Visual Pedestrian Signal. A signal that provides information about Pedestrian Timing in a visual manner.

Walk Indication. A method of informing the pedestrian that the Walk Interval has begun.

Walk Interval. The portion of the Pedestrian Timing during which the walking person, symbolizing “Walk,” is displayed, signaling that pedestrians are permitted to start to cross the street.

713.2 MATERIALS

713.2.1 Video Vehicle Detection System

The Contractor shall provide a system with the following performance requirements:

1. Complete intersection detection;
2. Automatic incident detection;
3. Freeway detection/management;

4. Freeway ramp control;
5. Vehicle counting/classification;
6. Collection of traffic statistics;
7. Turning movement analysis;
8. Wrong-way detection;
9. Enforcement;
10. Queue length analysis; and
11. Critical incidents in real time for traffic management.

The Contractor shall provide a system with the following Equipment, installation, and support requirements:

1. A Video Processor (VP) including the following:
 - 1.1. All necessary cables;
 - 1.2. Harnesses;
 - 1.3. Materials;
 - 1.4. Fittings;
 - 1.5. Field programming unit (FPU) as specified in the Contract;
 - 1.6. All field assistance during installation (if specified in the Contract);
 - 1.7. Software;
 - 1.8. Training during installation;
 - 1.9. Follow-up training;
 - 1.10. Technical support after installation; and
 - 1.11. Any miscellaneous components detailed in the Contract necessary to provide a complete and operating video detection system at signalized intersections;
2. Zoom lens closed circuit television (CCTV) cameras at each intersection, as specified in the Contract, with focal length and zoom determined by the manufacturer, to optimize performance;
3. Zoom lens camera (PTZ) for motorized pan and tilt operation with mounting assembly at each intersection with PTZ control receiver and driver when called for in the Contract;
4. Video hardware system, as specified by the manufacturer, consisting of components necessary to maintain the quality of video signal;
5. Video power cable compatible with the system; and
6. Video coax cable compatible with the system.

713.2.1.1 Video Processor

The Contractor shall provide a VP system that detects vehicles in multiple Traffic Lanes using a minimum of 100 user-definable detection zones. The Contractor shall provide a system with interactive graphics that allows a user to define or redefine detection zones. The Contractor shall ensure the VP calculates traffic parameters in real-time and provides local non-volatile data storage for later downloading and analysis.

The Contractor shall provide a VP system that is capable of simultaneously processing information from video sources, including CCTV video cameras and video players. The video sources may be synchronized or line locked. The Contractor shall ensure the system digitizes

and analyzes the video at a rate of 30 times per second.

The Contractor shall provide a VP system that detects the presence of vehicles in a minimum of 100 detection zones within the combined field of view of the cameras.

The Contractor shall provide a system that allows selection of different detector types and detector logical functions using software. Detector types include the following:

1. Counting;
2. Presence;
3. Directional presence;
4. Speed (capable of reporting vehicle classification based on length with software that allows a user to define three (3) length categories);
5. Station; and
6. Input.

The Contractor shall provide a VP system that a user can disconnect after set up using the FPU. The Contractor shall ensure the VP is capable of the following:

1. Detecting vehicles as a stand-alone unit;
2. Calculating traffic parameters in real-time; and
3. Storing traffic parameters in its non-volatile memory.

The Contractor shall provide a system with user-selectable time intervals (or time slices) of ten (10) s, 20 s, 30 s, one (1) min, five (5) min, ten (10) min, 15 min, 30 min, or 60 min. The Contractor shall provide a flash memory within the VP to retain time interval data for later uploading to the FPU for analysis.

The Contractor shall provide a system that allows retrieval of data stored in the non-volatile memory of the VP via a serial communications port or Ethernet port. The Contractor shall make provision for downloading data via a modem and dial-up telephone lines, DSL, Ethernet, private cable or fiber optic network, and direct cable connection to another computer.

The Contractor shall include the capability to capture a video image (snapshot) from a selected image sensor input and transmit the image to the FPU for display in the VP. The Contractor shall ensure the system can compress the captured video image to minimize the time needed to transmit the image.

713.2.1.2 Detection Zone Placement

The Contractor shall provide a video detection system that allows flexible detection zone placement anywhere and at any orientation within the combined field of view of the cameras. Lines placed across lanes of traffic or lines placed in-line with lanes of traffic when preferred or recommended by the manufacturer. The Contractor shall provide a system where a single detector line can replace multiple conventional detector loops connected in series. The Contractor shall ensure that the system allows overlapping of detection zones capable of implementing logical functions, including "AND," "OR," "NAND," "N of M," and Delay/extend timing.

713.2.1.3 Detection Zone Programming

The Contractor shall locate and place the detection zone with a FPU capable of showing images of the detection zones superimposed on the video image of traffic.

The Contractor shall provide a system that changes the color or intensity of the detection zone on the monitor when a vehicle is detected, verifying proper operation of the detection system. The system may use color changes to indicate detection Delay and extension timing.

713.2.1.4 Optimal Detection

The video detection system shall reliably detect vehicle presence when the camera is mounted 20 feet or higher above the Roadway, or as recommended by the manufacturer, and the length of the detection area or field of view is not greater than 10 times the mounting height of the camera.

The Department will require the camera to be mounted directly over the Roadway. The Contractor shall provide a system that allows a single camera, placed at the proper mounting location with the proper lens, to monitor from six (6) to eight (8) Traffic Lanes simultaneously.

The Contractor shall ensure that the system detects vehicle presence with 98% accuracy under normal conditions (Day and night) and 96% accuracy under adverse conditions (fog, rain, snow, etc.), using standard camera optics, and in the absence of occlusion.

713.2.1.5 VP Mounting

The VP shall be shelf or rack-mountable and be able to fit in a conventional Traffic Signal controller cabinet.

713.2.1.6 VP Environment

The VP shall:

1. Operate reliably in the adverse environment found in the typical roadside Traffic Signal controller cabinet;
2. Meet the environmental requirements of NEMA TS1 and NEMA TS2; and
3. Withstand operating temperature of from -29 °F to +165 °F at 0% to 95% relative humidity, non-condensing.

713.2.1.7 VP Electrical

The Contractor shall provide a VP, modular in design, with current micro processing technology. The Contractor shall use gold-plated DIN connectors for the bus connections used to interconnect the modules of the VP.

The Contractor shall provide a power supply for the VP that provides and automatically adapts to the following input power levels:

1. From 89 V to 135 V AC, 60 Hz single phase or 12V to 24V DC; and
2. Allow for surge ratings in accordance with NEMA TS1 and NEMA TS2.

The Contractor shall provide controller state information for detection and extend/Delay timing functions with NEMA red/green inputs for up to 16 phases. The Contractor shall provide an Acceptable connector on the front of the VP for the inputs.

The Contractor shall equip the VP with National Transmission Standards Committee (NTSC) (color) composite video inputs, so signals from cameras or other synchronous, or non-synchronous, video sources process in real-time. The Contractor shall use an Acceptable connector on the front of the VP for all video inputs.

713.2.1.8 Field Programming Unit System

When called for in the Contract, the Contractor shall provide a Field Programming Unit having communication capabilities as specified in the Plans as needed for set-up and viewing of vehicle detections. The Equipment manufacturers shall contact the Departments Traffic Signal design Engineer for approval prior to Bidding. This unit shall be considered Incidental to Video and Radar Vehicle Detection System.

The field programming unit shall be capable of driving an external current industry standard monitor, shall be capable of both battery and AC operation, and shall include required batteries, chargers, protective carrying case, and system software.

713.2.1.9 Closed Circuit Television (CCTV) Cameras

The Contractor shall provide a video detection system that uses standard or high-definition, closed circuit detection (CCD) cameras as the video source for real-time vehicle detection, as required by manufacturer's recommendations. The Contractor shall ensure that each camera meets the following minimum requirements:

1. Uses medium resolution, from ¼ inch to ½ inch, color cameras with a minimum of 470x400 TVL lines of resolution and an "auto-iris" motorized zoom lens selected uniquely for each site to optimize performance;
2. Uses NTSC, or CCIR video signals;
3. Each camera shall be housed, as a minimum, in NEMA 4 and IP66 water-resistant, dustproof and/or gas filled enclosure;
4. Uses a single industry Specification-connector for interconnection to video and power cables. Provide optional video and power cable configurations if requested;
5. Securely mounted (to minimize sway and motion) in the field using a bracket or pedestal mount and/or pan and tilt unit and with a field-adjustable zoom to provide optimal field of view;
6. Equipped with a video surge protection device, a ground wire, and an in-line junction of the coaxial cable. Fasten this device securely and wrap in watertight Material;
7. Field video cables terminate in the Traffic Signal controller cabinet on each VP camera interface panel. Ensure that the panel provides lightning protection and terminating junctions between the field and each VP. Provide terminal strips, lightning protection, and a ground buss for power cables from the cabinet to the cameras; and
8. When the connection between the camera and each VP is coaxial cable, the coaxial cable used shall be a low loss 75 ohm precision video cable suited for outdoor installation, such as Belden 8281 or West Penn P806 as specified.

713.2.2 Radar Presence Detector (RPD)

The Radar Presence Detector (RPD) is a Frequency Modulated Continuous Wave (FMCW) radar device that provides accurate vehicle detection at the stop bar, and has the following features:

1. Reports real-time presence of both moving and stopped vehicles;
2. Operating Frequency of 24.0 – 24.25 GHz (K-Band). K-Band provides the widest allowable bandwidth. This larger bandwidth provides a higher resolution signature with greater accuracy;
3. Real Time Presence Data in 10 Lanes;
4. The Availability of 16 zones and 16 channels with user selectable zone to channel

- mapping Zones can be linked together using OR and AND logic;
5. Fail-Safe Mode to put the intersection into recall if communication to the RPD is lost; and
 6. No Cleaning or Adjustment necessary to maintain performance.

713.2.2.1 Mounting and Positioning

1. Each RPD sensor shall be mounted on the backside of the opposing approaches mast-arm unless a special circumstance exists that prevents this mounting placement.
2. Each RPD sensor will be mounted at a height of 20 ft +/- five (5) ft. The mounting height will be no more than 35 ft and no less than 15 ft.
3. Each RPD sensor shall be capable of being mounted at a minimum of a ten (10) ft offset from the nearest lane of interest.
4. Each RPD sensor shall be aligned so that the area of detection begins five (5) ft downstream of the stop-bar and continues upstream for 140 ft.
5. Each RPD Sensor will be mounted on a six (6) inch, two (2)-axis heavy duty sensor mount that will be attached to the mast-arm by at least two (2) Band-it straps.
6. A 12 AWG stranded wire will be tapped to the pole and connected to the RPD's grounding lug.

713.2.2.2 Connections and Cabling

1. A cable with a brass Mil-Spec connector will be connected to the sensor and run down the pole into a junction box mounted to the backside of the signal pole or located per Signal Lab direction.
2. Silicon Dielectric Compound will be applied to the connection point between the sensor and the connector on the cable.
3. Bulk Cable will be terminated into the supplied junction box. The junction box will be located in the mast arm through the hand hole on the mast arm upright or outside the pole at a minimum of ten (10) ft. The bulk cable will be run from the junction box in the mast arm pole, thru conduit to the Traffic Signal cabinet.
4. Bulk Cable will be terminated into terminal blocks on a pre-assembled back plate located in the Traffic Signal Cabinet.

713.2.2.3 Traffic Cabinet Components

1. Each RPD system will have a pre-assembled backplate or cabinet interface installed into the traffic cabinet, which will include: AC/DC power conversion, Surge Protection, Terminal Blocks for cable landing, and Communication Connection points.
2. The RPD shall use contact closure input file cards with two (2) or four (4) channel capabilities or direct SDLC communication to the Traffic Controller. The contact closure input file cards for the RPD shall be compatible with industry standard detector racks.

713.2.2.4 Number of RPD's Per Intersection

1. There shall be one (1) RPD for each approach of the intersection requiring stop-bar detection.

713.2.2.5 Electrical

1. The RPD shall consume less than ten (10) W.
2. The RPD shall operate with a DC input between nine (9) VDC and 28 VDC.
3. The RPD shall have onboard surge protection.

713.2.2.6 Communication Ports

1. The RPD shall have two (2) communication ports, and both ports shall communicate independently and simultaneously.
2. The two (2) communication ports will allow remote communications without interrupting the operation of the RPD and its interface to the contact closure cards and Traffic Signal controller.

713.2.2.7 Configuration

1. The RPD shall have a method for automatically defining Traffic Lanes, stop bars and zones without requiring user intervention. This auto-configuration process shall execute on a processor internal to the RPD and shall not require an external PC or other processor.
2. The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPD configuration.
3. The RPD shall support the configuring of lanes, stop bars and detection zones in one (1) ft (0.3-m) increments.
4. The RPD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation.

713.2.2.8 Physical Properties

1. The Contractor shall provide an RPD unit consisting of an enclosure of that conforms to the NEMA 250 Standard for type 4X enclosures.
2. The Contractor shall obtain the operating voltage (115 V AC) for the pre-assembled backplate directly from the Traffic Signal Cabinet.
3. All external components of the RPD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration.
4. The RPD shall be able to withstand a fall of five (5) ft without compromising its functional and structural integrity.
5. The RPD shall include a connector that meets the MIL-C-26482 Specification. The Mil-C-26482 connector shall provide contacts for all data and power connections.

713.2.2.9 Radar Design

1. The RPD shall be designed with a matrix of radars.
2. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.
3. The RPD antennas shall be designed on printed circuit boards.
4. The RPD shall transmit a signal with a bandwidth of at least 245 MHz. This bandwidth provides the greatest accuracy for distinguishing closely spaced vehicles and gives the highest possible resolution.
5. The RPD shall provide at least eight (8) RF channels so that multiple units can be

mounted in the same vicinity without causing interference between them.

6. The RPD shall have a self-test that is used to verify correct hardware functionality.

713.2.2.10 Operating Conditions

1. The RPD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk.
2. The RPD shall be capable of continuous operation over an ambient temperature range of -40°F to 165.2°F (-40°C to 74°C).
3. The RPD shall be capable of continuous operation over a relative humidity range of five percent (5%) to 95% (non-condensing).

713.2.2.11 Warranty, Maintenance, and Support

1. The Contractor shall obtain and assign to the Department all manufacturers guarantees or warranties which are normally provided as customary trade practice for items and Materials incorporated into the Work. In the absence of a manufacturer's guarantee, the Contractor shall warrant that mechanical and electrical Equipment and Material incorporated into the Work are free from any defects or imperfections in workmanship and Material for a period of one (1) year after partial Acceptance of the Project. The Contractor shall be responsible for repairing any malfunction or defect in any such Equipment or Material, which develops during the one (1) year period.
2. The Contractor shall supply two (2) sets of installation guides and user manuals for the Equipment incorporated in the Project, one (1) of which shall be submitted to the Project Manager with submittal of manufacturers shop drawings.

713.2.3 EVOD System

The Contractor shall provide a system that uses optical communication or GPS to identify the presence of designated priority vehicles and causes the Traffic Signal controller to advance or hold a desired Traffic Signal display selected from normally available phases.

The Contractor shall provide an EVOD system with a matched set of components that identify the presence of (signal from) priority emergency vehicles and instruct the Traffic Signal controller to find and hold a desired Traffic Signal display.

The Contractor shall ensure that this communication is effective to the optical detectors at or near the intersection over a line-of-sight path of at least 2,300 ft.

The Contractor shall provide an EVOD system that operates on a first-come, first-served basis or on a selected priority basis and is designed to yield to other priority demands such as railroad crossings.

The Contractor shall interface the EVOD system with existing Traffic Signal controllers without compromising normal operation or existing safety provisions. The Contractor shall provide an EVOD system that consists of an optical emitter, optical detectors, optical detector cable, and phase selectors.

The Contractor shall ensure desired performance of the EVOD system by providing matched system components, proven through integrated testing and extensive functional experience. The Contractor shall provide matched system components that offer compatibility

with all types of Traffic Signal controllers, for example electromechanical, or solid-state, and provide future system compatibility of priority control elements.

713.2.3.1 EVOD Optical Emitter Assembly

EVOD optical emitters shall be a light-weight, weather resistant, user addressable, light-emitting device with internal regulated power supply. The Contractor shall ensure that the optical emitter assembly produces precisely timed, crystal-controlled optical energy pulses of high-intensity light from a single source, at a rate of from 14.035 Hz or 9.639 Hz, depending on the emitter control switch used.

713.2.3.2 EVOD Optical Detector

The Contractor shall provide lightweight, weatherproof, adjustable, single or dual-directional EVOD optical detector assemblies. The Contractor shall provide internal circuitry that transforms optical energy from the optical emitter assembly into electrical signals for delivery to the phase selection Equipment, through optical detector cable (up to 1,000 ft). It shall be programmable to detect addressable emitter.

The Contractor shall provide a high-impact polycarbonate unit constructed with non-corrosive hardware, designed for simple mounting at, or near, an intersection on mast arm, pedestal, pipe, or span wire, and operating over an air temperature range of from -22 °F to 140 °F.

The Contractor shall ensure the unit is responsive to the optical emitter at a distance of at least 1,800 ft and is capable of providing the necessary electrical signal to the phase selector through up to 1,000 ft of optical detector cable.

713.2.3.3 EVOD Optical Detector Cable

The Contractor shall provide durable EVOD optical detector cable with the necessary electrical characteristics to carry power to the optical detector from the phase selector and to carry the optical detector signal to the phase selector.

The Contractor shall provide three (3) conductors, AWG 20 (7 x 28) stranded and an individually tinned drain wire cable to provide signal integrity and transient protection. The Contractor shall use copper cable conductors shielded with aluminized polyester. The Contractor shall overlap the shield wrapping 20% to ensure shield integrity following conduit and mast arm pulls. The Contractor shall ensure the cable delivers the necessary quality signal from the optical detector to the phase selector over a non-spliced distance of 1,000 ft and sufficient power to the optical detector over a non-spliced distance of 1,000 ft.

The Contractor shall provide cable with an insulation rating of at least 600 V and a temperature rating of at least 176 °F.

The Contractor shall provide color-coded cables as follows:

1. Orange for delivery of optical detector power (+);
2. Blue for optical detector power return (-) or optical detector signal;
3. Yellow for optical detector signal; and
4. Bare for optical detector power return (-).

713.2.3.4 EVOD Phase Selector Assembly

The Contractor shall interface the EVOD phase selection assembly between the optical detectors and the controller unit. The Contractor shall not compromise the existing controller unit's fail-safe provision, and provide sufficient power for up to three (3) optical detectors per channel.

The Contractor shall ensure the assembly provides suitable sensitivity to the optical detector signal via adjustable range settings.

The Contractor shall provide a plug-in, two (2) or four (4)-channel, dual-priority assembly device intended for installation directly into the input file of control cabinets equipped with priority-phase selection software.

The Contractor shall power the assembly from AC mains and ensure the assembly contains an internal, regulated power supply to power optical detectors.

The Contractor shall ensure the assembly is capable of recognizing the following pulse rates as delivered by the optical detectors:

1. 9.639 Hz \pm 0.119 Hz as Frequency I; and
2. 14.035 Hz \pm 0.255 Hz as Frequency II.

The Contractor shall provide an assembly that delivers signals to the controller to cause selection of the desired phase green display for the approaching vehicle.

The Contractor shall provide a test switch for each channel to deliver Frequency I or Frequency II signal pulse rates to verify proper function at both optical emitter flash rates, first-come, first-served operation, and Frequency II override capability.

The Contractor shall provide a selectable call dropout time of five (5) s or ten (10) s, zero (0) to +2.5%.

The Contractor shall provide a modular, microprocessor controlled, two (2)-channel, four (4)-phase, high-priority phase selector expandable to a four (4)-channel, eight (8)-phase dual-ring controller. The Contractor shall ensure the phase selector continuously monitors all "GREEN," "WALK," and pedestrian clearance displays for a smooth transition from controller to phase selector interval timing.

713.2.3.5 EVOD Reliability

The Contractor shall ensure that Equipment supplied as part of the optical priority remote traffic control system intended for use in the controller cabinet meets the electrical and environmental Specifications of the NEMA standards.

The Contractor shall ensure that all Equipment supplied as part of the priority control system intended for use in or on emergency vehicles operates properly in air temperatures of from -20 °F to 140 °F, in air with relative humidity of from five (5) to 95%, and a vehicle battery voltage of from ten (10) V to 15 V.

713.2.4 Loop Vehicle Detector

The Contractor shall provide a self-contained, electronic sensing loop vehicle detector that registers the presence of a vehicle by recognizing inductance change in a loop of wire embedded in a Roadway.

The Contractor shall rack-mount the detector in a Traffic Signal controller cabinet. The

Contractor shall provide two (2)-channel type detectors with independent channel controls. If specified in the Contract, include a Delay/extension time function and/or count function for each channel.

The Contractor shall provide all loop vehicle detectors in accordance with NEMA TS1, Part 15, NEMA TS2, Inductive Loop Detectors.

713.2.4.1 Loop Detector Wire

The Contractor shall use No. 14 AWG stranded copper wire cross-linked polyethylene (XHHW) insulation conforming to requirements of IMSA Specification No. 51-3 for loop detector wire installations in pavement saw cuts.

713.2.4.2 Loop Lead-in Cable

The Contractor shall connect the loop installed in the pavement to the loop detector unit installed in controller cabinet with No. 16 AWG copper, polyethylene insulated twisted pairs, shielded and enclosed within a polyethylene-jacket lead-in cable. The Contractor shall provide loop lead-in cable in accordance with IMSA Specification No. 50-2.

713.2.4.3 Loop Detector Sealant

The Contractor shall use loop sealant as filler for loop saw cuts, and to secure and protect the loop wire. The Contractor shall provide sealant of sufficient strength and hardness to withstand stress and abrasion from vehicular traffic while remaining flexible enough to provide stress relief under thermal movement.

The following are additional sealant properties:

1. Ability to bond to concrete and asphalt;
2. Rapid cure rate allowing pavement opening to traffic ½ h after installation;
3. Initial fluidity permitting installation in a narrow saw cut down to at least 40 °F;
4. Moisture insensitivity allowing application to damp pavement effectively; and
5. Resistance to vehicular fluids and Road salt.

713.2.4.4 Ducted Loop Wire

The Contractor shall use ducted loop wire loosely encased in ¼ in outside diameter polyvinyl chloride (PVC) or polyethylene tube for insulation in pavement saw cuts or by directly overlaying with paving Material. The Contractor shall provide ducted loop wire in accordance with IMSA Specification No. 51-5, or use insulated PVC with a nylon jacket (THHN) or polyethylene (XHHW) for the interior No. 14 AWG stranded conductor.

713.2.4.5 Hot-Type Applied Loop Detector Sealant

The Contractor shall use a hot-melt, rubberized asphalt compound sealant provided in “bricks” formulated specifically to be stiff, non-tracking, flexible at low pavement temperatures, and suited for use as a sealant for traffic loop cuts, or as specified by the user agency.

The Contractor shall provide thin, free-flowing fluid sealant that pours easily, penetrates fine cuts, self-levels, and allows easy application at application temperatures. The Contractor shall melt sealant and apply to pavements in accordance with the manufacturer’s recommendations, using either pressure-feed melter applicator units or pour pots. The Contractor shall ensure that hot-applied sealants meet or exceed the property requirements in

Table 713.2.4.5:1, "Hot-Applied Loop Sealant Property Requirements," after curing.

**Table 713.2.4.5:1
Hot-Applied Loop Sealant Property Requirements**

Test	Procedure	Specification
Penetration @ 77 °F, 3.53 oz., 5 s	ASTM D 5329	35, maximum
Softening Point	ASTM D 36	180 °F, minimum
Ductility, 77 °F	ASTM D 113	6 inch, minimum
Mandrel Bend 180 °F, 5s, 1.07 in diameter	—	Pass
Pour temperature	—	380 °F, Minimum
Safe heating temperature	—	380 °F–420 °F

713.2.4.6 Cold-Applied Loop Detector Sealant

The Contractor shall apply sealant by conventional cartridge gun or bulk handling pump Equipment. The Contractor shall ensure that the uncured (wet) Material has a viscosity of approximately 20,000 cP at 77 °F using a Brookfield Viscometer, #6 spindle at 20 RPM, and nonvolatile content (solids) of from 75% to 85% by weight.

The Contractor shall provide Material that cures at a rate such that it is dry to the touch within 24 h, while being driven on almost immediately after installation. The Contractor shall provide non-shrink sealant that remains flexible at temperatures greater than or equal to -40 °F. The Contractor shall ensure that cold applied sealants meet or exceed the property requirements list in Table 713.2.4.6:1, "Cold Applied Loop Sealant Property Requirements," after curing.

**Table 713.2.4.6:1
Cold-Applied Loop Sealant Property Requirements**

Test	Procedure	Specification
Hardness	ASTM D 2240	65–85
Tensile strength	ASTM D 412	500 psi, minimum
Elongation	ASTM D 412	400%, minimum
Adhesion (peel strength) (Canvas to conc.)	ASTM D 903	15 lb, minimum
Arc resistance	ASTM D 49	71 s, minimum
Dielectric strength @ 50 Hz	ASTM D 150	6.35, minimum

713.2.4.7 Requirements

The Contractor shall provide loop detectors that use digital design throughout, for threshold, time, and cycle calculations. The Contractor may use the following techniques to determine a change in inductance:

1. Period measurement;
2. Time elapsed per cycle;
3. Frequency measurement; or

4. Cycles counted in a set time interval.

The Contractor shall ensure isolation of the channels with two (2)-channel construction to eliminate "cross talk" between adjacent loops. The Contractor shall provide period measurement detectors using alternate scanning to accomplish this isolation.

The Contractor shall provide a detector with a fail-safe to call feature on each channel to provide a detect output, if open circuit loops occur. The Contractor shall provide for a minimum composite loop inductive operating range of from 50 μ H to 1,000 μ H and allow up to 1,000 ft of loop lead-in. The Contractor shall provide self-tuning detectors with automatic tracking or detectors that require initial tuning with a minimum automatic drift compensation tolerance of \pm five percent (5%), after initial adjustment. The Contractor shall optically couple detector outputs. The Contractor shall provide a fail-safe (closed) output in case of power loss.

713.2.4.8 Testing

Before Project Manager Acceptance, the Contractor shall send the loop vehicle detectors to the Traffic Services Signal Laboratory in Santa Fe for testing and approval. The Department will test the detectors concurrently with the controller testing in accordance with Section 714.3.2, "Testing."

The Department will inspect and test loop vehicle detectors as follows:

1. Visual inspection for compliance with the Contract;
2. Sample tests in accordance with NEMA standards for the following:
 - 2.1. Sensitivity;
 - 2.2. Hold time;
 - 2.3. Long detection and recovery;
 - 2.4. Adjacent lane rejection; and
 - 2.5. Pulse mode re-phase.

The Department will base Acceptance on the satisfactory performance of the loop detectors for the test period in accordance with Section 714.3.2, "Testing."

713.2.5 Operation

The Contractor shall provide digital switches on the front panel or software for making operational selections or adjustments. The Contractor shall provide a minimum selection of three (3) frequency ranges and three (3) sensitivity (change in inductance) ranges along with a presence or pulse output mode and a reset selector. The Contractor shall separate and repeat controls for each channel.

The Contractor shall provide an LED output indicator on the front of each channel.

713.2.6 Two (2)-Channel Detectors

The Contractor shall provide active power inputs on both channels of two (2)-channel detectors, to allow independent operation of either channel without the remaining channel being connected. The Contractor shall ensure that connector terminal assignments are in accordance with NEMA Standards, Part 15. The Contractor shall rack mount detectors.

713.2.7 Lightning and Transient Protection

The Contractor shall provide detectors that meet NEMA requirements for transient testing. The Contractor shall accomplish this using metal oxide varistors for protection from voltage induced in loop lead-in cables installed in the cabinet, and flash-over protection from internal circuit to ground.

713.2.8 Pedestrian Detectors

713.2.8.1 Push-Button Station

The Contractor shall provide cast aluminum push-button station housing of tamperproof construction. The Contractor shall ensure the assembly is weatherproof and constructed so there is no possibility of electrical shock under any weather conditions.

The Contractor shall Shape the housing to provide a rigid installation that fits the curvature of the pole it attaches to. The Contractor shall provide a direct push-type actuator button, micro-switch type or approved equal in the housing body. The Contractor shall fit the housing cover snugly on the housing that contains the push-button sign.

The Contractor shall provide porcelain enameled sheet steel or sheet aluminum pedestrian push-button signs of 0.36 inch minimum thickness. The Contractor shall make the signs nine (9) inch × 12 inch.

If using porcelain enameled steel signs, the Contractor shall provide each hole with a brass grommet. The Contractor shall round sign corners.

The Contractor shall use black enamel on white enamel background to show instructions and arrows on the signs. The Contractor shall show the instructions in accordance with the Contract.

The Contractor shall finish push-button housings with two (2) coats of powder coat or best quality infrared oven baked paint as follows:

1. First Coat: Baked epon primer, zinc chromate, or equal; and
2. Second Coat: Flat black or when specified Federal yellow alkyd urea baked enamel matching Federal Standard 595 A Color Chip 33538.

713.2.8.2 Warranty, Maintenance, and Support for APS

1. The Contractor shall obtain and assign to the Department all manufacturers guarantees or warranties which are normally provided as customary trade practice for items and Materials incorporated into the Work. In the absence of a manufacturer's guarantee, the Contractor shall warrant that mechanical and electrical equipment and Material incorporated into the work are free from any defects or imperfections in workmanship and Material for a period of six (6) months after Acceptance by the Department. The Contractor shall be responsible for repairing any malfunction or defect in any such equipment or Material, which develops during the six (6) month period.
2. The Contractor shall supply two (2) sets of installation guides and user manuals for the Equipment incorporated into the Project, one (1) of which shall be submitted to the Department with submittal of manufacturers shop drawings.
3. During the warranty period, technical support by toll-free telephone shall be provided by the manufacturer.

713.3 CONSTRUCTION REQUIREMENTS

713.3.1 Video Detection System

The Contractor shall install the Video Detection system per the manufacturer's recommendations and provide assistance from the Supplier as described below for a period of two (2) years after the items have been Accepted:

1. Have the Supplier of the Video Detection system supervise the installation and testing of the video and computer Equipment. Have a factory representative from the Supplier set up, test, program, and adjust the system in the field at each temporary signal location and the final signal location. Have factory representatives conduct a one (1) Day training and programming session in conjunction with the setup and test for each signal location, if specified in the Contract;
2. During the manufacturer warranty period, ensure that the Supplier provides technical support by toll-free telephone;
3. During the manufacturer warranty period, ensure that certified personnel from the Supplier are on site within two (2) Working Days, if the Department requires;
4. Ongoing software support by the Supplier includes updates of each Central Video Processor (CVP) and the computer software; and
5. Have the Supplier maintain a program for technical support and software updates following expiration of the manufacturer warranty period.

713.3.2—Reserved

713.3.3 EVOD Optical Detector System

The Contractor shall install EVOD optical detector systems in accordance with the manufacturer's recommendations. The Contractor shall not allow the Equipment manufacturer to modify the existing traffic controller unit beyond adding the necessary hardware to the traffic controller cabinet.

713.3.3.1 System Training

The Contractor shall provide appropriate training and assistance to the Department's personnel and emergency vehicle operators in troubleshooting, maintenance, and system operation for the duration specified in the Contract. The Contractor shall submit the complete training program to the Department for approval, 15 Working Days before scheduling the training. The Contractor shall include in the training program submission, working outlines of presentations and manuals, handouts, and other Materials to be distributed during the training.

713.3.4 Loop Detectors

The Contractor shall install loop detector consisting of two (2) distinct elements. First, the Contractor shall install the loop (inductive coil) in the pavement, at the location, and geometry specified in the Contract, including a low-inductance lead-in cable back to the control cabinet. Second, the Contractor shall install the loop vehicle detector-sensing unit in the control cabinet, including wiring to output the presence of a vehicle. The Department will not Accept loop detector (total system) installations until the installation accurately detects the presence of vehicles in accordance with the Contract.

713.3.4.1 Loop Detectors Installation Requirements and Procedures

713.3.4.1.1 Saw Cuts

The Contractor shall make saw cuts using an abrasive cutting wheel concrete saw. The Contractor shall make saw cuts from 2¼ inch to 2½ inch deep and approximately 0.275 inch wide. The Contractor shall use a ¾ inch wide slot to install ducted loop wire.

If the Contract requires new pavement or additional paving Material overlay, the Contractor shall make the saw cut and wire installation at least below the last paving layer of ¾ inch or greater thickness. The Department will not allow saw cuts in the final layer of surfacing. In the case of pavement overlay, the Contractor shall make a saw cut a minimum of two (2) inches below the final surfacing elevation. The Contractor shall install piezoelectric detectors in accordance with the manufacturer's recommendations, which may require saw cutting of the open-graded friction course (OGFC).

If the Contract specifies heater-scarification pavement treatment, the Contractor shall make the saw cuts after completing this operation. The Contractor shall provide two (2) inch diameter holes, drilled at angle points to the same depth as the saw cuts. The Department will allow 45° angle cuts made at corners instead of drilled holes. The Department will not allow sharp corners greater than 45° between overlapping saw cuts. Also, the Contractor shall drill cut across concrete pavement expansion joints to allow wire slack. The Contractor shall overlap saw cuts by a sufficient length to provide a smooth bottom, even-depth wire channel. If there is more than one (1) loop terminating at a pull box, the Contractor shall provide each loop with a separate saw cut back to the box. The Contractor shall make these saw cuts no closer than six (6) inches. Before placement of the sealant and wire, the Contractor shall clean the saw cut of debris and standing water by blowing out with compressed air. The Department will allow the pavement surface to be damp to the touch. The Contractor shall ensure the inside of the saw cut is free of sharp protrusions from loose aggregate or uneven saw cuts.

713.3.4.1.2 Rigid Electrical Conduit Entrance

The Contractor shall provide a separate one (1) inch rigid electrical conduit entrance at the pull box for each loop. The Contractor shall begin the rigid conduit at the end of the pavement saw cut and run under any curb and gutter, and Sidewalk. The Contractor shall leave slack in wire through the conduit entrances, and seal the end of the conduit with a soft-setting butyl rubber or asphalt joint sealer. The Contractor shall fill the remainder of the hole with the appropriate Material and approved saw cut sealant.

713.3.4.1.3 Loop Wire Placement

The Contractor shall place a continuous run of loop wire in the saw cut and wind around the coil section the number of turns specified in the Contract, or directed by the Project Manager. The Contractor shall install no more than four (4) wires or turns in a single saw cut. The Contractor shall leave wire run through drilled corners and joint crossings slack. The Contractor shall encapsulate the slack portion of wire with a soft-setting butyl rubber or asphalt joint sealer. The Contractor shall install at the ducted loop wire during a paving operation by securely attaching the loop in the proper shape to the pavement surface and overlaying with the next paving layer(s) of two (2) inches or greater total thickness is allowable. The Contractor shall secure the loop before overlaying by placing the ducted wire in a slot cut in the pavement, or by securing the corners using a method approved by the Project Manager, then covering the wire by hand with a small amount of asphalt paving Material. The Contractor shall not bend the ducted loop wire to less than a one (1) inch radius.

713.3.4.1.4 Sealant Application

The Contractor shall not place sealant, if the air temperature is below 40 °F or if precipitation is occurring or impending. The Contractor shall place sealant in accordance with the manufacturer's recommendations.

The Contractor shall place sealant in saw cut using a special nozzle. The Contractor shall fill the saw cut to within approximately 1/8 inch of the top. The Contractor shall not allow spillover onto the pavement surface; immediately strike off excess Material.

713.3.4.1.5 Multiple-Loop Systems

If using a multiple-loop system (same channel), the Contractor shall wind adjacent loops with opposite rotations. The Contractor shall accomplish rotation reversal by reversing leads at the pull box. The Contractor shall mark the beginning of the loop wire and the pull box before beginning the winding process to identify the direction of rotation. The Contractor shall connect multiple loops in series to the lead-in cable at the pull box or splice point.

713.3.5 Loop Lead-in Cable Installation

The Contractor shall run loop lead-in cable continuously from the loop wire splice to the terminal in the control cabinet. The Department will not allow splices in the lead-in cable.

The Contractor shall connect the drain (ground) wire in the lead-in cable to earth ground at the cabinet end only. The Contractor shall neatly clip off the ground wire at the curbside pull box adjacent to the end of the outer jacket.

The Contractor shall solder connections between the loop wire and the lead-in cable. The Contractor shall not use open flame torches for soldering. The Contractor shall make splices waterproof by stripping from 1/4 inch to 1/2 inch of the insulation, and inserting into a self-sealing epoxy-filled twist-on connector in accordance with Section 711.3.4.1, "Spring-Type Connector." The Contractor shall use of a two (2)-part sealant, DBY-3M #3570 connector sealant, or approved equal is allowable.

The Contractor shall wrap #3570 connector splices with a high-quality all-weather electrical recording, or approved self-bonding recording, by overlapping the wire insulation approximately one (1) inch and in layers equal to or greater than 1 1/2 times the thickness of the original wire insulation. The Contractor shall seal the outer jacket of the cable in a similar manner, except overlap the recording on the outer jacket four (4) inches.

If using ducted loop wire, the Contractor shall apply sealant at the end of the tube portion and then wrap with recording to prevent water entry. The Contractor shall suspend the "V" splices formed high in the pull box to prevent immersion in water.

713.3.6 Integrity Test Check

After completing loop installation in the Roadway, the Contractor shall check each loop with a megger, if required, to ensure the integrity of the installation. The Contractor shall ensure that the resistance of each loop is greater than 100 MΩ. If directed by the Project Manager, the Contractor shall check the completed loop detector system in accordance with Section 713.2.3.8, "Testing."

713.3.7 Push-Button Stations

The Contractor shall mount push-button stations on the side of Traffic Signal poles with the arrow sign indicating the direction of pedestrian movement. If an extension is required for ADA requirements, a maximum of one (1) ft is allowable.

713.3.7.1 Installation and Operational Requirements

713.3.7.1.1 Walk Indication and Pushbutton Information Message

When Pushbutton-Integrated APS serving separate crosswalks are installed on two (2) separate poles on a single street corner or other locations with pedestrian crosswalks separated by at least ten (10) ft at the same crossing, the Audible Walk Indication shall be a Rapid Tick.

When Pushbutton-Integrated APS serving separate crosswalks are installed on the same pole, the Audible Walk Indication shall be a Speech Message.

Where the Visual Pedestrian Signal is a fixed time signal (i.e., does not require pedestrian activation), the Accessible Pedestrian Signal shall also be a fixed timed signal.

The Audible and Vibrotactile Walk Indications shall be repeated for the entire duration of the Walk Interval, except as provided below:

1. This paragraph applies only to a situation in which a pedestrian signal (i) is used to assist pedestrians crossing a minor street that intersects a major street; (ii) stays in a rest-in-walk status; and (iii) only changes to "Don't Walk" when a pedestrian pushes the button to cross the major street, or a vehicle activates the signal to cross the major street. In such situations, and where technology provided by the APS manufacturer provides the option, when the duration of the rest-in-walk status is longer than seven (7) seconds, the audible walk indication will terminate after seven (7) seconds but the vibrotactile walk indication will stay on throughout the rest-in-walk status.
2. Alternatively, if technology provided by the APS manufacturer permits, when the duration of the rest-in-walk status is longer than seven (7) seconds, the audible and vibrotactile walk indications will terminate after seven (7) seconds. These non-visual walk indications will be re-activated during the rest-in-walk status whenever a pedestrian pushes the button to cross the minor street and there is sufficient time remaining in the pedestrian phase for the pedestrian change interval.

713.3.7.1.2 Volume Settings

The Pushbutton Locator Tone and Walk Indication emitting from the Pushbutton Housing shall be audible, under varying conditions of ambient sound, five (5) feet to ten (10) feet from the pushbutton, or to the building line of the nearest building, whichever is less. When the pushbutton is pressed and held for one (1) second or more during the flashing or steady "Don't Walk" phase, the volume of the Walk Indicator and Locator Tone will be increased for a maximum of two (2) cycles. Under such circumstances, the volume of the Locator Tone shall be increased during the Pedestrian Change Interval only.

Volume shall be increased for one (1), or if available from the manufacturer, two (2) Pedestrian Timing cycles following a button press of one (1) second or more.

713.3.7.1.3 Text Requirements

Raised characters, text, symbols, pictorial symbol signs, and Braille where provided shall conform to the requirements of the Contract.

713.4 METHOD OF MEASUREMENT—Reserved

713.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>CVP</i>	Each
<i>Video Cable</i>	Foot
<i>Video Camera</i>	Each
<i>Video Hardware System</i>	Each
<i>Radar Presence Detector (RPD)</i>	Each
<i>Optical Detector, ___Direction, ___Channel</i>	Each
<i>Optical Detector Cable</i>	Foot
<i>Optical Emitter</i>	Each
<i>Loop Detector Wire</i>	Foot
<i>Ducted Loop Detector Wire</i>	Foot
<i>Loop Lead-in Cable</i>	Foot
<i>Detector Saw Cut</i>	Foot
<i>Phase Selector Rack, ___Channel</i>	Each
<i>Phase Selector Module</i>	Each
<i>Accessible Pedestrian Signal Push Button Station</i>	Each

The Department will pay for conduit for detector installations in accordance with Section 709, "Rigid Electrical Conduit."

713.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for Radar Presence Detector (RPD) and will not be measured or paid for separately:

1. RPD Sensor, Sensor Mount, Sensor Cable, splice box, preassembled back plate and two (2) channel detector card for interface to Traffic Signal controller; and
2. When the number of approaches has been established to create one (1) detection unit, no additional payment shall be made for integration.

SECTION 714: TRAFFIC SIGNAL CONTROLLERS

714.1 DESCRIPTION

This Work consists of providing and installing traffic-actuated controllers, special auxiliary control Equipment, and cabinets.

714.2 MATERIALS

714.2.1 Traffic-Actuated Controller

These *Standard Specifications* and the National Electrical Manufacturers Association (NEMA) standards describe required features, functions, and test procedures for traffic-actuated controllers. The Contractor shall provide TS2-Type 1/Type 2 controllers for State-maintained signalized intersections. The Contractor shall provide TS2 compatible controller Equipment. The Contractor shall not modify controllers, cabinets, wiring harness, and other Equipment tested and approved by the State Signal Maintenance Lab. The Contractor shall obtain State Traffic Technical Support Engineer approval of Equipment in writing.

The Contractor shall ensure controllers meet all requirements for a solid-state surface mount, NEMA, traffic-actuated controller. The Contractor shall provide controllers that use the current designs employing microprocessors.

Unless otherwise specified in the Contract, the Contractor shall provide microprocessor controllers of a modular design. The Contractor shall provide controllers that consist of a main processor unit (MPU), input/output interface, and a power regulator. Power transformer and capacitors may be rigidly fixed to the frame. The Contractor shall ensure modules are easy to remove.

The Contractor shall provide multi-terminal, Military Specification (Mil-Spec)-type plugs for Standard and special function input/output electrical connections on the front of the controller in accordance with NEMA interface Standards, or Department-approved controllers with RS-232-C Standard input/output ports. The Contractor shall provide RS-232-C ports for communications and special functions. The Contractor shall equip controller cabinet with a K-1 failouts relay in the back panel.

The Contractor shall provide battery or super cap backup in the same module for power-down clock operation and battery or super cap-backed random-access memory (RAM) for non-programmed data such as message logs for a minimum of 72 hours.

The Contractor shall provide controller ports with the following capabilities:

1. Direct interface with a personal computer for uploading and downloading program data; and
2. Direct interface with a serial or Ethernet port for remote communications with a personal computer and/or network connection.

The Contractor shall provide port connections that prevent interruption to signal operation.

The traffic-actuated controller shall have the capability to report alarms to central computer remotely, without assistance from a System Master unit.

The Contractor shall provide controllers with a keyboard and liquid crystal display (LCD) or touch screen on the front. The Contractor shall ensure the display has an adjustable

contrast and backlighting. The Contractor shall ensure the controller design allows time based coordination and preemption programming through the controller keyboard. The Contractor shall provide controllers that can display alphanumeric timing, status, and programming information. The Contractor shall ensure each ring has a separate display for simultaneous, dual-ring display. The Contractor shall ensure the display has two (2) modes of operation: the run mode current phase that displays interval and remaining interval time; and the programming mode that displays the phase, interval or programmable function, and the time or value.

714.2.1.1 Programming Requirements

The Contractor shall provide controllers with a keyboard for entering operator timing and functional data into nonvolatile memory and with a menu-driven interface and to enter, revise, and display operator data using a minimal number of keystrokes. The Contractor shall ensure key functions are clearly displayed on the front of the controller. The Contractor shall ensure the controller is capable of storing operator data for at least 30 Days after disconnecting the primary power.

The Contractor shall provide controllers capable of being programmed in different patterns of phase sequences: quad-left, sequential, or a combination of concurrent and sequential. The Contractor shall ensure the following:

1. The controllers allow programming of inactive phases.

The Contractor shall provide a controller that displays operator-entered times or values, before entering into memory. The Contractor shall ensure the controller does the following:

1. Allows automatic sequencing through the programming;
2. Prevents unauthorized changes in the programming mode with a four (4)-digit numeric security code; and
3. Allows access to view stored information.

714.2.1.2 Internal Preemption

The Contractor shall provide controllers with internal preemption, capable of railroad or emergency-vehicle preemption sequences. The Contractor shall ensure that the internal preemption feature allows for at least six (6) independent preemption programs. The Contractor shall make it possible to prioritize preemption; Delay before preemption, cycle during preemption and hold phase assignments, and provide for pedestrian clearance through initial clearance yellow. The Contractor shall ensure preemption intervals can be timed, and operator data programmed through the controller keyboard. The Contractor shall ensure operator-entered preempt data is printable. The Contractor shall provide railroad preemption in accordance with the *Manual on Uniform Traffic Control Devices, current edition*, requirements and include a track clearance phase. The Contractor shall ensure return-to-normal controller operation is in accordance with the plan-phasing diagram, and place a detector call on phases as specified in the Contract.

714.2.1.3 Internal Coordination

The Contractor shall provide controllers with internal time based coordination. The Contractor shall provide synchronization and control functions for coordinating actuated signalized intersections, without the use of interconnecting cables. The Contractor shall ensure coordination can be made on a time of Day, Day of week, and week of year basis. The Contractor shall provide a coordinator that functions as a Standard signal system coordinator, using Force Offs, Holds and Phase/Ped Omits outputs, and Phase Green inputs, capable of

supervising the controller. The Contractor shall ensure that the coordinator maintains the accuracy of the AC line frequency and without line voltage to an accuracy of at least $\pm 0.005\%$.

The Contractor shall provide battery or super cap backup capable of maintaining real time and memory for at least 72 hours. The Contractor shall provide a time clock that keeps track of time of Day in seconds, Day of week, and date and programmable automatic daylight savings time changes. If a power disruption occurs, the Contractor shall ensure that the coordinator will automatically restart itself once line voltage returns. The Contractor shall provide a coordinator capable of 100 program changes, selectable on the minimum basis of ten (10) daily program groups, two (2) weekly programs, and ten (10) exception Days (Holidays). The Contractor shall ensure that the program change selectable to at least a minute, on or off of any single function.

The Contractor shall provide coordinators with minimum selectable system options of five (5) cycles, four (4) splits per cycle, three (3) offsets per cycle, three (3) permissive periods per split, one (1) pedestrian permissive period per split, and three (3) force-offs per split. The Contractor shall ensure that the coordinator has selectable cycle settings from zero (0) s to 255 s in one (1)-second increments, or as a percentage of the cycle length. Offsets, permissive periods, and force-off points may be programmable from zero (0) s to 255 s in one (1)-second increments, or as a percentage of the cycle length. The Contractor shall provide selectable offset seeking for dwell or add only, or smooth offset transitions.

The Contractor shall ensure manual selection of any program. The Contractor shall provide for selectable coordinated phase(s) programmed as required in the Contract. The Contractor shall ensure that displays show the current time of Day, date, cycle countdown, current Plan in effect, hold, force-off, sync outputs, and all programmed data as they occur.

714.2.1.4 General Design Requirements

714.2.1.4.1 Components

The Contractor shall provide timing circuits consisting entirely of solid-state surface mount electronic circuitry that use state-of-the art large-scale integration (LSI) circuit techniques. The Contractor shall provide cross reference and data sheets showing the parameters of all solid-state devices used.

The Contractor shall ensure that all switching functions operate using solid-state surface mount electronic circuitry. The Contractor shall not use electromechanical devices such as time/break relays or rotary, stepping, or line-switches for switching functions.

The Contractor shall provide printed circuit board assemblies consisting of surface mount technology that meet NEMA requirements for Traffic Signal controllers. The Contractor shall cover current-carrying traces with a solder mask Material. The Contractor shall coat boards containing components with a humidity sealant. In addition, the Contractor shall clearly mark circuit reference designations immediately adjacent to each component.

The Contractor shall de-rate all components with regard to heat-dissipating capacity and rated voltage so that in operation, under maximum air temperature and maximum applied voltage, there is no life shortening of the Material or shift in values. The Contractor shall ensure the design life of components operating 24 h a Day is at least five (5) years.

714.2.1.4.2 Constancy of Intervals

The Contractor shall provide a controller designed so that the length of any interval, portion, period, or unit extension may be set to two (2) significant digits and will remain within that accuracy level through an air temperature range of from 30 °F to 165 °F, with a line frequency of 60 Hz ± 0.3 Hz. This performance includes cold and hot starts, obtained without the use of a power-consuming heating or cooling apparatus.

714.2.1.4.3 Power

The Contractor shall provide controllers and associated Equipment that use 115 V, 60-cycle, single-phase AC power.

714.2.1.4.4 Mechanical Construction

The Contractor shall provide controllers housed in either aluminum or steel sheeting or in a Department-approved housing with a durable finish.

The Contractor shall plug printed circuit boards into receptacles within the controller and provide with fastening devices to prevent loss or loosening during transportation or handling.

The Contractor shall provide controller assemblies interchangeable with those of the same manufacturer and series.

714.2.1.4.5 Environmental, Interface, and Functional Requirements

The Contractor shall provide controllers in accordance with current NEMA Standards TS2, or the latest NEMA Standards.

714.2.1.5 Controller Requirements

The Contractor shall provide internal programmed NEMA overlaps within the controller. The Contractor shall provide keyboard operator programming.

714.2.1.5.1 Phase Timing

The Contractor shall provide timing intervals for each traffic phase. The Contractor shall ensure the interval and minimum range of adjustment of the timing intervals is in accordance with Table 714.2.1.5.1:1, "Timing Intervals and Minimum Range of Adjustment."

**Table 714.2.1.5.1:1
Timing Intervals and Minimum Range of Adjustment**

Interval	Timing range (s)	Maximum resolution (second increments)
Initial or minimum	0-255	1
Extension (gap)	0-25.5	0.1
Yellow change	0-25.5	0.1
Red clearance	0-25.5	0.1
Maximum (Max 1)	0-255	1
Maximum (Max 2)	0-255	1
Walk	0-255	1
Pedestrian clearance	0-255	1
Red revert	0-25.5	1

714.2.1.5.2 Phase Control Functions

The Contractor shall ensure each phase is capable of the following functions:

1. Max Recall (Non Act). Automatically returns the phase and extends green timing to that of maximum green. In absence of an opposing phase demand, the controller rest in green;
2. Ped Recall (Non Act). Automatically returns phase to walk-ped clearance and vehicle Right-Of-Way without vehicle and pedestrian demand;
3. Veh. Recall (Ext.). Automatically places a recurring demand for vehicle service without actual vehicle demand when not in its green interval;
4. Non-Locking (Memory Off). Phase operates in fully actuated mode. Memory of vehicle demand is retained only when a vehicle is in the detection zone (detector outputting); and
5. Locking (Memory On). Phase operates in fully actuated mode. Memory of vehicle demand (detector output) is retained in the phase until that phase is served.

714.2.1.6 Operational Requirements

714.2.1.6.1 Timing Requirements

The Contractor shall provide an initial interval control for each phase that determines the guaranteed minimum green period for that phase. The minimum green period consists of the sum of the walk interval and the greater of the pedestrian clearance interval or minimum green interval with pedestrian or pedestrian and vehicle actuation.

The Contractor shall ensure that each phase provides vehicles additional green time beyond the minimum green time by vehicle actuations by means of an extension interval control. The Contractor shall ensure that successive actuations cancel the remainder of the previous extension interval and initiate a new extension interval for the vehicle that provided the actuation. Should transfer of right-of-way occur while an extension interval is un-expired, the Contractor shall ensure that the right-of-way returns at the next opportunity in the cycle.

The Contractor shall equip each phase with at least two (2) maximum green timing interval controls that set a limit on the time that continuous traffic during The Right-Of-Way phase can be extended, after an actuation is registered for any conflicting phase. Maximum interval (MAX 1) is for normal operation. Maximum interval (MAX 2) is for external and internal input.

The Contractor shall provide each phase with a clearance period consisting of a yellow change interval and a red clearance interval, both of preset duration.

The Contractor shall ensure that the presence of a pedestrian is registered upon actuation of a pedestrian push button during a pedestrian clearance interval, or whenever the "Don't Walk" signal is displayed, so that the walk signal occurs at the next assignment of Right-Of-Way to the phase. The Contractor shall ensure that the phase is capable of recycling and providing pedestrian and pedestrian clearance intervals when a pedestrian actuation is registered on a phase with no demand for pedestrian or vehicular Right-Of-Way on a conflicting phase. The pedestrian clearance interval is the minimum and guaranteed pedestrian protection. The Contractor shall ensure that the "Don't Walk" display is steady during the remaining right-of-way and clearance intervals.

714.2.1.6.2 Phasing Requirements

The Department does not want the Equipment to give the Right-Of-Way to any Street without an actuation (call). In the absence of traffic or recall option, the Department wants the Right-Of-Way to remain on the Street where it was last assigned, unless the "RED REST" option is implemented. If the "RED REST" option is used, the Contractor shall ensure that the controller cycles to all red and remains until a phase call.

The Contractor shall provide controllers that operate in a concurrent phase timing, dual-ring or sequential, single-ring configuration. The Contractor shall number and operate all phases in accordance with a NEMA dual-ring (quad-left) configuration or sequential configuration. The Contractor shall provide controllers capable of operating at least eight (8) field phases.

The Contractor shall provide controllers capable of assigning the Right-Of-Way to a single phase or any combination of non-conflicting phases. The Contractor shall specify phases skipped on each ring for no demand, and recall functions for each phase for sequential controllers. The Contractor shall provide controllers capable of providing at least four (4) overlap phases in any phase combination, and programmable on both a Standard NEMA plug-in overlap program board and operator keyboard entry.

714.2.1.6.3 Input/Output Features

The Contractor shall provide all controllers with all input/output features per phase, ring, and unit in accordance with NEMA Functional Standards. The Contractor shall wire any unused inputs or outputs to the controller and identify on the controller back panel per NEMA.

714.2.1.6.4 Initialization Requirements

The Contractor shall provide controllers with an initialization control to start at the beginning of:

1. The programmed green, yellow, or red interval of the selected phase(s);
2. The application of power;
3. The external start input; and
4. As specified in the Contract.

The Contractor shall place vehicle and pedestrian calls on phases.

714.2.2 Traffic Control Systems

The Contractor shall ensure all systems meet the design, operational, and communication requirements specified in the Contract.

714.2.2.1 System Master

The Contractor shall provide a traffic-adjusted, arterial or multi-system, microprocessor design System Master. The Contractor shall provide units that shelf-mount in the controller cabinet with Mil-Spec or RS-232-C type connectors, and house in a metal cabinet in accordance with Section 714.2.1.5, "Controller Requirements."

714.2.2.2 Closed Loop System

The Contractor shall provide a closed loop computer advanced traffic management system (ATMS) that controls, operates, and supervises a Traffic Signal control system consisting of:

1. A computer facility for uploading and downloading traffic data;
2. A communications network;
3. Field Equipment;
4. System training; and
5. Alerts.

The Contractor shall equip the system with software and peripheral Equipment that is compatible with the existing controllers.

The Contractor shall obtain pre-approval from the State Traffic Technical Support Engineer for the proposed system components. The Department will reject the proposed Equipment, if shop drawings are submitted before obtaining pre-approval of the State Traffic Technical Support Engineer.

The Contractor shall Implement timing Plans, if required. Peripheral Equipment, communication Equipment, and field programming unit are a part of timing Plans, if specified in the Contract.

The Contractor shall have a traffic engineering consultant collect the data for turning movements for each intersection and develop a minimum of three (3) signal-timing Plans for the system at peak morning hours, peak mid-day hours, and peak evening hours as determined by the Project Manager or State Traffic Technical Support Engineer. The Contractor shall ensure that these Plans outline the objective, minimize intersection and overall system Delays, and indicate the trade-offs between mainline optimization and side Street operations, including follow up timing adjustments and/or fine tuning as required by the Department.

714.2.2.2.1 System Training

The Contractor shall provide a traffic engineering consultant to train Department personnel for two (2) Days and assist in the following tasks:

1. Operation of program Arterial Master Controller or control system;
2. Uploading and downloading traffic data;
3. Intersection and coordination timing;
4. Volume, occupancy, and standard and custom reports;
5. Counting traffic through system detectors;
6. Troubleshooting;
7. Maintenance; and
8. Initial system operation for progressive traffic movement.

The Contractor shall submit the complete training program to the Traffic Operations Engineer for approval, 15 Working Days before training is scheduled. The Contractor shall include working outlines of presentations, videorecordings, and all manuals, handouts, and other Materials to be distributed during the training in the training program.

714.2.2.3 Controller Interconnect Systems

The Contractor shall provide controller interconnect systems in accordance with the Contract.

714.2.2.4 Equipment Approval

The Department's State Traffic Technical Support Engineer will approve all Equipment.

714.2.2.5 Delay/Extend Operation

If specified in the Contract, the Contractor shall include an option for Delaying or extending detection outputs for each channel. The Contractor shall include switches to select Delay, extend or Delay time, extension or timer off operation for loop vehicle detectors. The Contractor shall ensure the minimum range and steps are zero (0) s to 30 s in one (1)-second increments for Delay time, and zero (0) s to 7.5 s, in 0.5-second increments, for extend time.

714.2.3 Cabinets, Support Equipment, and Wiring

The Contractor shall provide the components of the controller in a sturdy, weatherproof metallic controller cabinet.

714.2.3.1 General

Unless otherwise specified in the Contract, the Contractor shall wire all cabinets for the full application of all phases, pedestrian signals on all through movements, and all normal overlaps for either four-phase single-ring operation, or eight (8)-phase dual-ring operation. The Contractor shall provide wiring for all vehicle detection. The Contractor shall furnish the cabinet so that it is only necessary to add load switches, vehicle detectors, disconnect any jumpers, and rearrange field conductors in order to implement any initially unused phases or functions.

Unless specified in the Plans, all controllers and cabinets shall be assembled and tested at the controller's point of origin.

The Contractor shall fabricate all ground-mounted cabinets of aluminum that is at least ¼ inch thick. The Contractor shall fabricate pedestal cabinets of aluminum at least ¼ inch thick. The Contractor shall provide barrier type terminal blocks.

The Contractor shall design and manufacture all cabinets for rigid mounting with no flexing. The Contractor shall provide lifting tabs for all cabinets. The Contractor shall ensure that the types, internal components, and wiring arrangements of controller cabinets for an installation provide a complete operating traffic control system.

714.2.3.1.1 Cabinet Design

The Contractor shall design the cabinet with one (1) door in the front and one (1) door in the back and include a Corbin-tumbler lock Number 1548-1 for each door. The Contractor shall provide an auxiliary door equipped with a treasury-type lock Corbin Number R3575G5 for a police key on the front cabinet door.

The Contractor shall provide door handles that accommodate a padlock in the closed position. The Contractor shall provide a rain channel over the door openings to prevent liquids from entering the enclosure. The cabinet door opening must cover at least 80% of the cabinet's front surface. The Contractor shall weld a stiffener plate across the inside of the doors to prevent flexing. The Contractor shall slope the top of the cabinet toward the rear to prevent accumulation of water.

The Contractor shall seal all seams with continuous weld on the interior of the cabinet. The Contractor shall provide an in-door weatherproof and dust-proof, closed cell, neoprene gasket seal for the main door and police door to close against.

The Contractor shall provide louvered air entrances in the lower section of the cabinet door that satisfy the NEMA rod entry test for 3R ventilated enclosures. The Contractor shall provide an air inlet at least 16 inch × 20 inch. The Contractor shall secure a non-corrosive, vermin- and insect-proof, removable air filter to the air entrance. The Contractor shall fit the filter fit snugly against the cabinet door wall. The Contractor shall provide a one (1)-piece, continuous piano hinge for each door with a stainless steel pin that runs the entire door length, mounted on the right side when facing the cabinet. The Contractor shall attach hinges without rivets or bolts.

714.2.3.1.2 Cabinet Shelving

The Contractor shall support the controller and auxiliary Equipment with metallic shelves or brackets. The Contractor shall provide at least two (2) shelves, unless approved otherwise by the Department. The Contractor shall support both ends of the shelves with angle-type braces. The Contractor shall provide shelves strong enough to support the Equipment weight without sagging.

714.2.3.1.3 Control Cabinet Equipment Accommodation

The Contractor shall provide control cabinets large enough to:

1. Stand the controller assembly and associated Equipment upright on the shelving;
2. Remove the controller assembly straight out without turning it sideways; and
3. Close the door without interfering with the wire harness running to the door.

The Contractor shall not place Equipment on the floor of ground-mounted cabinets. The Contractor shall ensure that it is possible to remove all Equipment and wall-mounted devices without relocating or unpacking devices. The Contractor shall not allow cabinet wiring to obscure the front panels of control Equipment.

714.2.3.1.4 Control Cabinet Dimensions

The Contractor shall size cabinets as shown in Table 714.2.3.1.4:1, "Control Cabinet Dimensions Requirements," or as specified in the Contract. The Contractor shall meet the space requirements of Section 714.2.3.1.3, "Control Cabinet Equipment Accommodation."

**Table 714.2.3.1.4:1
Control Cabinet Dimensions Requirements**

Type of cabinet	Outside dimensions H x W x D (inch)	Use
G	33 x 20 x 14	If specified on Plans
M	48 x 30 x 16	If specified on Plans
MS	54 x 38 x 24	4-phase single-ring operation
P	54 x 38 x 24	8-phase dual-ring operation
R	72 x 38 x 24	If specified on Plans

714.2.3.1.5 Cabinet Mounting Hardware

The Contractor shall provide ground mount type cabinets with internal bolts for controllers, unless otherwise required in the Contract. The Contractor shall have anchor bolts and templates for cabinet installation on site before installing the concrete base for the controller.

714.2.3.1.6 Cabinet Finish

1. The Contractor shall cabinet finish per user agency; or
2. For powder coating, the Contractor shall use the following two (2) coat finish:
 - a. A four (4) stage iron phosphate coating, and
 - b. A triglycidyl isocyanurate polyester powder coat paint matching Federal Standard 595A Color Chip 27886, with a minimum thickness of two (2) mm.

714.2.3.2 Cabinet Wiring, Terminals and Facilities

The Contractor shall provide wiring, terminals, and facilities within the cabinet in accordance with NEMA TS2, or the latest NEMA Standards.

The Contractor shall perform all field flash sequence programming at the field terminals using only a screwdriver or flash color plug. The Contractor shall not debus the field terminal blocks for flash programming.

The Contractor shall provide field terminal blocks wired with four (4) positions per vehicle or overlap phase (green, yellow, red, and flash). The Contractor shall ensure that all harness and cabinet wiring is neat, firm, and bound together with cable tie wraps or equivalent. The Contractor shall meet the gauge and color requirements in Table 714.2.3.2:1, "Back Panel Wiring Requirements."

**Table 714.2.3.2:1
Back Panel Wiring Requirements**

Description	Wire color	Gauge
Green/Walk load switch output	Brown	14
Yellow load switch output	Yellow	14
Red/Don't Walk load switch output	Red	14
CMU (other than AC power)	Violet	22
Controller I/O	Blue	22
AC + (power panel to main panel)	Black	8
AC + (main panel)	Black	10
AC - (power panel to main panel)	White	8
AC - (main panel)	White	10
Chassis ground (power panel)	Green	8
DC ground	Grey	22
Flash programming	Orange	14

The Contractor shall meet MIL-W-16878/1, type B/N, 600 V, 29-strand tinned copper for 14 AWG and thinner wire. The Contractor shall ensure that the wire has at least 0.02 inch thick PVC insulation with clear nylon jacket and rated to 220 °F, 600 V.

The Contractor shall secure all connecting cables and wire runs with mechanical clamps. The Contractor shall not use stick-on type clamps. The Contractor shall isolate logic ground and chassis ground from each other within the cabinet. The Contractor shall not tie chassis ground and AC together within the cabinet. The Contractor shall hook or loop all wire around the eyelet or the terminal block post before soldering to ensure circuit integrity. The

Contractor shall not use lap joint soldering, butt type connections, or splices. The Contractor shall ensure that all cabinet wiring is continuous from its origin to its termination point.

The Contractor shall permanently number and label all back panel, D interface panel, and detector panel terminal blocks. The Contractor shall make all pedestrian push button inputs from the field to the controller opto-isolated or relay-isolated to prevent transients and AC from entering the controller.

714.2.3.2.1 Back Panel

The Contractor shall use a back panel and power bus panel to terminate all DC logic wiring. The Contractor shall locate this panel on the back of the cabinet below the Equipment shelves and include the load bay and the flasher-flasher relays. The Contractor shall ensure that all terminals and plug-in units are accessible without moving any Equipment.

The Contractor shall permanently pre-wire the back panel to the controller harness, conflict harness, and detector inputs. The Contractor shall make DC wiring connections ¼ inch quick-connect tab type, 300 V and 20 A rated. The Contractor shall mechanically strip the wire ¼ inch, and solder or firmly crimp the tab covering the wire and insulation. The Contractor shall solder AC connections on the panel back and all connections to the load switch/flasher receptacles.

The Contractor shall bring all NEMA functions to the front of the panel with a screw type connector. The Contractor shall ensure that it is possible to program, using jumpers such as clips or wires, the signal outputs for all the types of phasing operations possible for the specified controller, and to access all NEMA functions on the front for future auxiliary Equipment. The Contractor shall clearly mark the terminal functions on the back panel with the appropriate NEMA designation. When the auxiliary Equipment logic is specified in the Contract, the Contractor shall make connections on the front of the panel.

The Contractor shall mount the panel with clearance between the cabinet wall and the panel's back connections. The Contractor shall ensure that it is possible to drop the panel in the field (access back wiring) using simple hand tools. The Contractor shall rack mount the load bay, including flasher. The Contractor shall adequately support the load switches and flasher after insertion to prevent falling out due to vibrations.

The minimum positions for plug-in units are listed in Table 714.2.3.2.1:1, "Load Switch/Flasher Unit Positions."

**Table 714.2.3.2.1:1
Load Switch/Flasher Unit Positions**

Type of cabinet	Load switch positions	Flash relay positions	NEMA flasher
Phase single ring	8	2	1
8-phase dual-ring	16	4	1

714.2.3.2.2 Power Distribution Panel

The Contractor shall locate the power distribution panel on the lower right-hand side of the cabinet and fully enclosed to prevent accidental shock. The Contractor shall include the main power feed terminal (barrier type), the required AC protection from lightning (EDCO SPA-300 surge arrester or approved equal), filter (RFI), MOV to ground, with a removable cover, and any National Electrical Code® requirements in the power panel.

714.2.3.2.3 Detector Panel and Rack

The Contractor shall provide a detector panel on the left-hand side of the cabinet. The Contractor shall provide terminal blocks (barrier type) with removable buss bars for all detectors and pedestrian push-button field conductors. The Contractor shall include the “J” pin conductor appropriately terminated for extend/Delay operation on the detector rack.

The Contractor shall provide detector rack positions in accordance with Table 714.2.3.2.3:1, “Required Detector Rack Positions,” Table 714.2.3.2.3:2, “Four (4)-Phase Single-Ring Operation 16-Channel Detector Rack Order of Positioning,” Table 714.2.3.2.3:3, “Eight (8)-Phase Dual-Ring Operation 16-Channel Detector Rack Order of Positioning,” and Table 714.2.3.2.3:4, “Eight (8)-Phase Dual-Ring Operation Additional Detector Rack.” The Department will not require detector racks when video vehicle detection is used.

**Table 714.2.3.2.3:1
Required Detector Rack Positions**

Type of cabinet	Detector rack positions	Detector terminal blocks
4-phase single-ring	16	16
8-phase dual-ring	16	16
8-phase dual-ring	Up to 32	Up to 32

**Table 714.2.3.2.3:2
4-Phase Single-Ring Operation 16-Channel Detector Rack Order of Positioning**

PH1	PH2	PH4	PH2EC	PH1	SD1	SD2	SD4
PH3	PH2	PH4	PH4EC	PH3	SD3	SD2	SD4

**Table 714.2.3.2.3:3
8-Phase Dual-Ring Operation 16-Channel Detector Rack Order of Positioning**

PH1	PH2	PH6	PH2EC	PH3	PH4	PH8	PH4EC
PH5	PH2	PH6	PH6EC	PH7	PH4	PH8	PH8EC

**Table 714.2.3.2.3:4
8-Phase Dual-Ring Operation Additional Detector Rack^a**

Dual lefts			System detectors and preemption				
PH1	PH3	SD1	SD2	SD6	SD3	SD4	SD8
PH5	PH7	SD5	SD2	SD6	SD7	SD4	SD8

^aProvide only additional channels required on Plans

The Contractor shall provide connector/pin assignments (Two (2) x 22 pin edge card connector with 0.156 in contact centers, key slots located between B and C, and M and N) in accordance with Table 714.2.3.2.3:5, “Connector/Pin Assignments.”

**Table 714.2.3.2.3:5
Connector/Pin Assignments**

Connector/pin	Assignment
A	DC (-) common
1	Call Delay inhibit (Channel 1)
B	DC (+) power

**Table 714.2.3.2.3:5
Connector/Pin Assignments**

Connector/pin	Assignment
2	Call Delay inhibit (Channel 2)
C	Reset
4 and D	Loop # 1
5 and E	Loop # 1
F	Output # 1A Opto-coupler (Collector)
H	Output # 1A Opto-coupler (Emitter)
8 and J	Loop # 2
9 and K	Loop # 2
L	Chassis ground
S	Output 1B AccuCount FET (Drain)
w	Output # 2A Opto-coupler (Collector)
x	Output # 2A Opto-coupler (Emitter)
y	Output # 2B AccuCount FET (Drain)
z	Output # 1C Fail FET (Drain)
19	Output # 2C Fail FET (Drain)

714.2.3.2.4 “D” Connector Panel

The Contractor shall provide a “D” connector panel and harness with each cabinet assembly on the left-hand side of the cabinet and fully wired to provide all functions. The Contractor shall ensure the panel contains provisions for mounting two (2) 120 V AC relays for preempt inputs 1 A, 2 A, and ¼ A fuse for each relay.

714.2.3.2.5 Terminal Labeling

The Contractor shall number and identify all terminals. The Contractor shall not use the same nomenclature used on the controller assembly-wiring diagram, such as phase numbers.

714.2.3.2.6 Telemetry Interface Panels

The Contractor shall provide each cabinet assembly with a telemetry interface harness and printed circuit board interface panel to support and protect communications required.

The Contractor shall provide the telemetry interface panel with a socket-mounted, communication line transient protection device wired in series with the telemetry communication circuit where copper is used. The Contractor shall match the communication line impedance with the transmitter output impedance to minimize line noise.

714.2.3.2.7 Wiring Diagrams

The Contractor shall provide two (2) sets of wiring diagrams for each cabinet. The Contractor shall provide a plastic envelope in the cabinet to house one (1) cabinet wiring diagram. The Contractor shall submit these wiring diagrams with the Equipment to the Department Signal Laboratory before testing begins. For Projects, the Contractor shall include city and intersection names on the diagrams.

The Contractor shall show the connectors for all Equipment and switches, relays, and flashers on the cabinet wiring diagrams.

714.2.3.2.8 Additional Required Terminals, Protection Devices, and Switches

The Contractor shall provide the following additional terminals, protection devices, and switches for all cabinets:

1. A UL-listed 20 A circuit breaker for filtered AC power serving all solid-state devices including load switches;
2. A separate 20 A circuit breaker for AC circuit serving the ground fault circuit interrupter (GFCI) outlets, fan, and light;
3. A separate 20 A circuit breaker for advance warning flasher, if specified in the Contract;
4. Copper ground strip, mounted and ground to cabinet wall, for connection of all common conductors;
5. Terminate all field signal output circuits on an unfused terminal block with a minimum rating of 15 A. Provide AC field terminals with a screw with diameter at least $\frac{7}{16}$ inch;
6. Provide terminal blocks to terminate a special Equipment harness. Locate these terminals on the right-hand side of the cabinet, above the power distribution panel;
7. Terminals for connecting interconnect cable tie points and inter-cabinet, termination when required. Provide transient protection on all external lines;
8. One (1) quad outlet for Equipment mounted on the upper left hand side of the cabinet. A second duplex GFCI convenience outlet for tools and testing Equipment mounted on the upper right hand side of the cabinet. Use NEMA Type 5-15R outlets;
9. Switches behind police auxiliary door including:
 - 9.1. Main switch, identified "On-Off," wired to turn off signal light power when switched to off position and to de-energize the field lighting. Provide a 20 A minimum rated switch and connecting wiring;
 - 9.2. Auto flash switch, identified "Auto Flash," wired to keep controller energized and to place signals on flash when switched to flash position. Provide a controller with stop timing that applies, when in the flash position;
10. Interior cabinet switches including:
 - 10.1. Interior Switches and Convenience Outlet. Combine on a single panel and mount on the inside of the cabinet door, unless otherwise noted. Provide heavy duty and rated at least 15 A switches, except for the main switch. Cover any exposed terminals or switch solder points with a nonflexible shield. Permanently label switch functions. Protect wire routed to the police door, in door, and test push button panel against damage from opening and closing of the main door;
 - 10.2. Test Switch. A two (2)-position switch, labeled "Auto Flash," wired to de-energize the signal light power when switched to flash position, and to allow the controller to cycle through its normal sequences while displaying flash indications on signals;
 - 10.3. "Controller On/Off" Switch. A two (2)-position switch, labeled "Controller On/Off," wired to de-energize the controller and auxiliary Equipment when switched to the off position;

- 10.4. Vehicle and Pedestrian Detector Switches. Two (2)-position momentary switches labeled "ON, TEST," wired to each vehicle and pedestrian detector input to allow the substitution of manual call into each controller detector input. Identify switches as to phase or function;
- 10.5. Preemption Test Switches. Provide test switches to allow a manual preempt input. Provide each preemption phase with a separate switch with each phase that is appropriately identified;
- 10.6. Door Ajar/Open Switch. Include a door switch for each cabinet to log an event to the System Master that the door is open or ajar;
- 10.7. LED Light Door Switch. Include a door switch for each cabinet that turns the cabinet LED lights on when the cabinet door is open;
- 10.8. Load switches and flashers shall be discrete;
11. Radio line filter (RFI) for filtering AC lights and to control power for solid-state light control and controller operation; and
12. Pedestrian push-button isolation (field circuit) to protect solid-state devices from transient voltages, (to prevent transients from being induced in the open pedestrian push-button circuits by isolation transformers, or by opto-isolation).

714.2.3.2.9 Additional Cabinet Features

The Contractor shall provide the following additional cabinet features:

1. Cabinet Fan. Mount a thermostatically controlled, manually adjustable fan in the controller cabinet, set to turn on at cabinet temperatures of from 70 °F to 160 °F. Locate the fan near cabinet vent holes to direct the airflow over the controller unit. Cover the inside opening with a maximum ¼ inch mesh screen to prevent the operator from contacting the fan blades. Provide a filter for the cabinet intake fan vent;
2. LED Light. Mount a LED fixture in the cabinet over the door; position to minimize damage when sliding Equipment off shelves. Mount a LED fixture on the bottom of the cabinet shelf, position to minimize damage. Secure LED lights separately when transporting to avoid breakage;
3. Door Stops. Provide a stop for each controller cabinet door of 22 inch or greater width, or six (6) ft² or greater area to lock the door opening at both 90° and 180°, ± ten degrees (10°). Provide the stop with a catch for the 180° position, so it stays open until released.

714.2.3.2.10 Solid State Signal and Pedestrian Load Switches

The Contractor shall provide signal load switches external to the controller and carried in the back panel load bay. The Contractor shall provide signal control load switches in accordance with NEMA Standards.

The Contractor shall provide a signal control assembly consisting of a separate plug-in unit containing the control circuitry for the operation of three (3) separate signal lamp circuits. The Contractor shall provide interchangeable vehicle and pedestrian control assemblies. The Contractor shall not use any unused output of each control assembly for any other function or phase, unless otherwise specified in the Contract.

The Contractor shall provide circuitry consisting of solid-state electronic components. The Contractor shall not use mechanical relays for the opening and closing of signal light circuits or for any other purpose. The Contractor shall provide a design life of five (5) years or more for all components operating 24 h a Day in their circuit application.

The Contractor shall rate all load switches at least 15 A. The Contractor shall include three (3) LED indicators on the face of each load, visible through the door opening of the cabinet, and connected to the input functions.

714.2.3.2.11 Solid-State Flasher

The Contractor shall provide each controller cabinet with two (2) NEMA type 3, 15 A minimum per circuit, dual-circuit, solid-state flasher sockets external to the controller and carried in the back panel load bay. The Contractor shall provide solid-state flashers in accordance with NEMA Standards.

The Contractor shall provide open, multi-contact plug type flasher transfer relays. The Contractor shall provide enough relays to allow any combination of flashing RED or YELLOW indications. The Contractor shall wire one (1) RC network in parallel with each group of three (3) flash transfer relays, and any other relay coils. The Contractor shall make all flash transfer relay sockets Cinch-Jones #2408SB or equivalent. The Contractor shall ensure that it is possible to isolate the controller's DC signals to and from the load switches by the use of removable links. The Department prohibits modifications on the back of the main panel.

714.2.3.2.12 Malfunction Management Unit (MMU-16)

A malfunction management unit shall be furnished with each Traffic Signal controller cabinet. All (MMU-16E, or MMU-16LE Smart Monitor with Ethernet port where required) units shall be the self-contained, shelf mounted type with the appropriate NMEA MS, Port 1 SDLC, RS232 and ethernet Connector(s). The Specification sets forth the minimum requirements for a shelf-mountable, sixteen channel, solid-state Malfunction Management Unit (MMU). The MMU shall meet, as a minimum, all applicable sections of the most current **NEMA Standards Publication**. Where differences occur, this Specification shall govern.

- 1. Monitoring Functions**

The following monitoring functions shall be provided in addition to those required by the NEMA Standard Section 4;

- 2. Dual Indication Monitor**

Dual Indication monitoring shall detect simultaneous input combinations of active Green (Walk), Yellow, or Red (Don't Walk) field signal inputs on the same channel;

- 3. Dual Indication Monitoring**

Sixteen switches labeled FIELD CHECK/DUAL ENABLES shall be provided on the MMU front panel to enable Dual Indication Monitoring on a per channel basis;

- 4. GY-Dual Indication Monitor**

GY-Dual Indication monitoring shall detect simultaneous inputs of active Green and Yellow field signal inputs on the same channel;

- 5. Field Check Monitoring**

Sixteen switches labeled FIELD CHECK/DUAL ENABLES shall be provided on the MMU front panel to enable Field Check Monitoring on a per channel basis;

- 6. Field Check Monitor**

- 7. Field Check Status**

- 8. Recurrent Pulse Monitoring**

- 9. External Watchdog Monitor**

The MMU shall provide the capability to monitor an optional external logic level output from a Controller Unit or other external cabinet circuitry;

10. **Walk Disable Option**

The MMU shall provide the capability to exclude the Walk inputs from the Red Fail fault detection algorithm when operating in the Type 12 mode;

11. **Type Fault Monitor**

12. **Configuration Change Monitor**

13. **CVM Log Disable**

The MMU shall provide a means to disable the logging of CVM fault events;

14. **Display Functions**

The following display functions shall be provided in addition to those required by the NEMA Standard Section 4;

15. **Full Intersection Channel Status Display**

16. **Fault Channel Status Display**

17. **Field Check Status Display**

18. **Recurrent Pulse Status Display**

19. **Type 12 Mode Indicator**

The Type 12 Indicator shall illuminate when the MMU is programmed for Type 12 operation;

20. **Type 12 Mode Indicator**

The DUAL INDICATION indicator shall illuminate when a DUAL INDICATION Fault is detected;

21. **Power Indicator**

22. **Port 1 Receive Indicator**

23. **Port 1 Transmit Indicator**

24. **RS232 Receive Indicator**

25. **Program Card/CF Indicator**

26. **Y+R Clearance Indicator**

27. **Field Check Fail Indicator**

28. **Operating Modes**

The MMU shall operate in both the Type 12 mode and Type 16 mode as required by the NEMA Standard;

29. **Hardware, Enclosure**

Overall dimensions, including mating connectors and harness, shall not exceed 10.5 inches x 4.5 inches x 11 inches (H x W x D).

- a. The enclosure shall be constructed of sheet aluminum with a minimum thickness of 0.062 inches, shall be finished with an attractive and durable protective coating. Model, serial number, and program information shall be permanently displayed on the top surface;

30. **Electronics**

A microprocessor shall be used for all timing and control functions. Continuing operation of the microprocessor shall be verified by an independent monitor circuit, which shall force the OUTPUT RELAY to the de-energized "fault" state and indicate an error message if a pulse is not received from the microprocessor within a defined period not to exceed 500 ms.

- a. High speed sampling techniques shall be used to determine the true RMS value of the AC field inputs. Each AC input shall be sampled at least 32 times per line cycle. The RMS voltage measurement shall be insensitive to phase, frequency, and waveform distribution;
- b. In the interest of reliability, only the PROM memory device for the microprocessor firmware shall be socket mounted. The PROM Memory socket shall be a precision screw machine type socket with gold contact finish providing a reliable gas tight seal. Low intersection force sockets or sockets with "wiper" type contacts shall not be Acceptable;
- c. All user programmed configuration setting shall be stored in an electricity erasable programmable read-only memory (EEPROM) or front panel DIP switches. Designs using a battery to maintain configuration shall not be accepted;
- d. All 120 VAC field terminal inputs shall provide an input impedance of at least 150K ohms and be terminated with a resistor having power dissipation rating of 0.5 Watts or greater;
- e. All electrical components used in the MMU shall be rated by the component manufacturer to operate over the full NEMA temperature range of -34°C to +74°C;
- f. All printed circuit boards shall meet the requirements of the NEMA Standard plus the following requirements to enhance reliability:
 - i. All plated-through holes and exposed circuit traces shall be plated with solder;
 - ii. Both sides of the printed circuit board shall be covered with the solder mask Material;
 - iii. The circuit reference designated for all components and the polarity of all capacitors and diodes shall be clearly marked adjacent to the component. Pin #1 for all integrated circuit packages shall be designated on both sides of all printed circuit boards.;
 - iv. All electrical mating surfaces shall be gold plated;
 - v. All printed circuit board assemblies shall be coated on both sides with a clear moisture-proof and fungus-proof sealant.

31. Front Panel & Connectors

All displays, configuration switches, and connectors shall be mounted on the front panel of the MMU. All MMU configuration inputs beyond those required by the NEMA Standard shall be provided by front panel mounted DIP switches and shall be clearly labeled. Configuration DIP switches shall be provided for the following functions:

Field Check / Dual Enables 1-16

- a. GY-Dual Indication Enable (GY ENABLE);
- b. Recurrent Pulse Test Disable (RP DISABLE);
- c. External Watchdog Enable (WD ENABLE);
- d. Walk Disable (Type 12);
- e. Configuration Change Fault Enable (CF ENABLE);
- f. CVM Log Disable.

32. MS Connectors

33. EIA-232 Port or Ethernet

The EIA-232 port or Ethernet shall be electrically isolated from the MMU electronics using optical couplers. The connector shall be an AMP 9721A or equivalent nine (9) pin metal shell D subminiature type with female contacts. Pin assignments shall be as shown in the following table:

PIN	FUNCTIONS
1	DCD*
2	TX DATA
3	RX DATA
4	DTR (Data Terminal Ready)
5	SIGNAL GROUND
6	DSR*
7	DSR*
8	CTS*
9	NC

*Jumper options shall be provided to allow the connection of Pin #4 to be made with Pin #7, and the connection of Pin # 8 to be made with Pin #1 and or Pin #6.

- 34. **Event Logging Functions**
- 35. **Monitor Status Report (CS)**
- 36. **Previous Fault Log (PF)**
- 37. **AC Line Event Log (AC)**
- 38. **Monitor Reset Log (MR)**
- 39. **Configuration Change Log (CF)**
- 40. **Signal Sequence Log (SSQ)**

714.2.4 Remove and Reset Signal Controllers and Controller Cabinets

If the Contract requires the Contractor to remove or reset signal controllers or controller cabinets, the Contractor shall use Materials for new foundations in accordance with Section 708, "Foundations for Signal and Lighting Installations." The Contractor shall use new anchor bolts for resetting controller cabinets. The Contractor shall provide anchor bolts fabricated from high strength steel bars with minimum yield strength of 55,000 psi, or steel in accordance with AASHTO M 314.

714.3 CONSTRUCTION REQUIREMENTS

714.3.1 General

If the Contract specifies new traffic-actuated controllers and controller cabinets, the Contractor shall provide controllers and cabinets from the same manufacturer. If the Contract requires a System Master, the Contractor shall provide a System Master and controller from the same manufacturer.

The Contractor shall install Traffic Signal controller cabinets on concrete bases, if specified in the Contract, or as directed by the Project Manager. The Contractor shall face the cabinet door away from the Street, unless otherwise specified in the Contract. Upon installation of a ground-mounted controller cabinet, the Contractor shall place the necessary caulking between the cabinet and concrete base to create a weather-resistant and dust-tight seal. The Contractor shall not place conduit entries into the side of the cabinet.

714.3.1.1 Foundations

The Contractor shall install foundations and anchor bolts for control cabinets in accordance with Section 708.3.2, "Control Cabinet Foundations."

714.3.2 Testing

The Contractor shall transport the controllers and cabinets, and any specified auxiliary Equipment to the Traffic Services Signal Laboratory in Santa Fe. The controller Cabinet including all associated internal components shall be assembled and tested at the manufactured point of origin. Documentation and/or certification of tests performed at the factory shall be provided for each Controller Cabinet, including make, make model number(s), and serial number(s). Controller Cabinets and internal components shall be shipped as one (1) unit. The Equipment will have appropriate written documentation including Project identification, signal Plan sheets, and transmittal letter(s). After receipt of all controller Equipment and associated internal components with supportive documentation that satisfy the fore-mentioned requirements, NMDOT signal Laboratory personnel will begin testing of the Controller Cabinet(s) for a minimum 15 Day or Maximum 30 Day test. The testing will be completed prior to the Project Manager's Acceptance of compliance with these Specifications:

1. Visual inspection to ensure compliance with Contract requirements for arrangement of Equipment, specified markings, and workmanship;
2. Operational testing including:
 - 2.1. Specified phasing;
 - 2.2. Various timings;
 - 2.3. Indicators;
 - 2.4. Pedestrian phasing;
 - 2.5. Auxiliary functions and interconnects;
 - 2.6. Flash mode;
 - 2.7. Possible conflicts for fail safe;
 - 2.8. Preemption interruption with every function and phase, when applicable;
 - 2.9. Load switches at 1,800 W;
 - 2.10. Interrupted power test;
 - 2.11. Timings and operation at input voltage of 105 V and 130 V AC; and
 - 2.12. Air temperature of 160 °F ± 30 °F for no more than 15 Days.

The Project Manager will reject the controller if its operation or components do not pass these tests. If a component fails, all testing will stop and the Department will require the removal and replacement, or repair, of the component and repair of the controller. The Contractor shall submit new Equipment or resubmit repaired Equipment for testing. Once the Lab test is completed and the Equipment Accepted, the Contractor shall transport the controller and cabinet from Santa Fe to the Project site.

In addition to the Lab test, the Project Manager and Signal Lab Technician will final Accept of all controllers and cabinets in accordance with Section 705.3.5.2, "Operation Tests."

714.3.3 Turn-On

The Contractor shall not turn-on controllers and auxiliary Equipment after installation, until the Signal Lab Technician inspects and approves the entire signal system.

The Contractor shall provide the Project Manager, Traffic Services Signal Laboratory, Signal Design Engineer, and the Maintaining Agency written notice at least ten (10) Working Days before the anticipated turn-on time. Personnel of the Department signal Laboratory, and the Maintaining Agency must be present during the initial turn-on. If specified in the Contract, the Contractor shall ensure that the qualified manufacturer's representative is present at the turn-on and conducts a training session for special controller Equipment.

The Contractor shall remove conflicting traffic control signing after turn-on, as directed by the Project Manager.

714.3.4 Modifications

If the Contract requires modifications or additions to an existing cabinet, the Contractor shall use a qualified signal manufacturer's representative to perform this Work.

Cabinet wiring diagrams from the Traffic Services Signal Laboratory in Santa Fe are available. The Contractor shall return proposed modifications to these wiring diagrams to the Department's Signal Design Engineer and obtain approval before starting any cabinet modification Work. Signal Lab personnel or delegated representatives must inspect the Work before the system is re-energized.

714.3.5 Removing and Resetting of Signal Controller

If the Contract specifies the removal or reset of a signal controller, the Contractor shall disconnect the existing controller from the cabinet, remove the controller and relocate it to the new location, and reinstall the controller in a new or used controller cabinet.

714.3.6 Remove and Reset Signal Controller Cabinet

The Contractor shall construct a new foundation at the specified location, then remove the existing cabinet and relocate the signal controller cabinet to the new foundation, using new anchor bolts.

The Contractor shall reconnect field wiring including loop lead-in cables, detection, power, pedestrian pushbuttons, signals, and signal controllers, to provide a complete and operational signal.

714.4 METHOD OF MEASUREMENT—Reserved

714.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Traffic-Actuated Controller</i>	Each
<i>System Master</i>	Each
<i>_____(Type) Controller Cabinet</i>	Each
<i>Closed Loop Traffic Control System</i>	Lump Sum
<i>Remove and Reset Signal Controller</i>	Each
<i>Remove and Reset Controller Cabinet</i>	Each
<i>Controller Interconnect System</i>	Each

SECTION 715: BEACONS and TEMPORARY SIGNAL EQUIPMENT

715.1 DESCRIPTION

This Work consists of providing and installing hazard identification beacon units (HIBU), radar feedback units, rectangular rapid flashing beacon (RRFB) and temporary signals.

Each complete HIBU, A/C Power feed consists of the following:

1. Beacon Assembly (A/C Power Feed);
2. One (1) Section Traffic Signal Assembly;
3. Type I Standard (15 feet), and foundations;
4. Sign Panels; and
5. External A/C power, meter, wiring, and conduit system.

Hazard Identification Beacon Unit, Solar Powered - Each complete HIBU, Solar Powered consists of the following:

1. Beacon Assembly (Solar Powered);
2. One (1) Section Traffic Signal Assembly;
3. Type I Standard (18 feet), and foundations; and
4. Sign Panels.

715.2 MATERIALS

There are two (2) types of Beacon Assembly based on power source which can be A/C power Feed or Solar Powered.

715.2.1 A/C Power Feed

Beacon Assembly (A/C powered) consists of flasher controller, flasher with or without time clock, and either pole mounted or ground mounted cabinets. The assembly includes all internal wiring, conduits, and hardware or Material to make a complete and working unit in the HIBU. Additional options maybe indicated as needed. The options are Incidental to Beacon Assembly and may include but not limited to the following:

1. Internet connectivity;
2. Modem;
3. Two (2)-way radio;
4. WiFi or Alpha pager controlled;
5. GPS enabled; and
6. Battery backup.

715.2.1.1 Flasher Controller

The Contractor shall provide a flasher controller assembly including a flasher, cabinet, and time clock. The Contractor may mount the assembly on the side of the pole or place it in a ground-mounted cabinet. The Contractor shall provide a meter in accordance with the Plans.

715.2.1.2 Flasher

The Contractor shall provide a flasher unit with an alternating two (2)-circuit (115 V AC), solid-state plug-in type with a 15 A or greater rating per circuit. The Contractor shall design the unit to plug into a pre-NEMA electro mechanical base (five (5)-banana jack, female base) type or (five (5) socket, male base) type. The Contractor shall ensure the units are interchangeable among the types used. The Contractor shall provide flasher units in a solid state with no moving parts. The Contractor shall provide units that use zero (0) voltage switching with 50% on time, and a flash rate of from 50 to 60 per minute. The Contractor shall provide flasher units designed to operate at full capability in air temperatures ranging from negative thirty degrees (-30°) F to 160° F.

715.2.1.3 Pole-Mounted Beacon Control Cabinet

The Contractor shall provide a cabinet made of sturdy, cast or sheet aluminum housing with a hinged main door equipped with a lock for a police key. The Contractor shall provide two (2) police keys with each cabinet.

The Contractor shall provide a cabinet at least 12 inch wide x ten (10) inch high x six (6) inch deep, or as required to house the specified Equipment. The Contractor shall ensure switches and controls are accessible through the front door. The Contractor shall provide side-of-pole mounting cabinets. The Contractor shall provide access to the cabinet through a hole located in the bottom and top, drilled and threaded to Accept a 1 1/2 inch galvanized rigid conduit, unless otherwise specified in the Plans. All cabinets (inside and outside surfaces) shall be finished as follows:

1. Cabinet finish per user agency;
2. For powder coating, the Contractor shall use the following two (2) coat finish:
 - a. A four (4) stage iron phosphate coating;
 - b. A triglycidyl isocyanurate polyester powder coat paint matching Federal Standard 595A Color Chip 27886, with a minimum thickness of 2mm. The Contractor shall provide neat and firm cabinet wiring. The Contractor shall lace or, bind together, wiring and harnesses with Ty wrap or an equivalent. The Contractor shall number and identify terminals in accordance with a cabinet-wiring diagram provided by the Supplier. The Contractor shall ensure that the flasher cabinet includes the following terminals, protection devices, and switches;
3. Terminal (barrier type) for 115 V AC power feed;
4. Main power supply circuit breaker with at least a 15 A rating;
5. One (1) terminal (barrier type) for each circuit for field conductor to beacons;
6. Signal shutdown switch that does not affect clock power;
7. Copper ground strip grounded to the cabinet for connection of common conductors;
8. Terminal (barrier type) for time switch opening and closing;
9. Radio line filter for filtering AC power; and
10. Lightning arrester for filtering lightning or high voltages to the ground for protection of Equipment.

If specified, the Contractor shall provide a flasher controller including a time switch. The Contractor shall provide a time switch using a weekly time clock programmable for the on/off function up to eight (8) times a Day and 40 times a week. The Contractor shall ensure the switch/controller allows a user to vary or omit a Day program. The Contractor shall provide time switches that a user can program with a keyboard and/or digital switches. The Contractor shall provide an LED display of the time of Day and keyboard entered data.

715.2.1.4 Ground-Mounted Beacon Control Cabinet

The Contractor shall provide NEMA 3R and 12, rain tight ground-mounted beacon control cabinet, electrically welded and reinforced where specified in the Plans. The Contractor shall provide stainless steel nuts, bolts, screws, and hinges. The Contractor shall provide phenolic nameplates. The Contractor shall mark control wiring at both ends with permanent wire markers and attach a plastic covered wiring diagram to the inside of the front door. The Contractor shall provide a factory-wired cabinet in accordance with NEMA Standards, and bearing a UL 508 label.

715.2.1.5 Time Clock

The Contractor shall provide a time clock with an automatic Daylight Savings Time correction. The Contractor shall ensure the time switch allows the flashing field indications to be turned on or off manually or on a time of Day basis. The Contractor shall mount the time clock unit on the backside of the door.

All cabinet wiring shall be neat and firm. All wiring and harnesses shall be laced or bound together with Ty wrap or equivalent. All terminals shall be numbered and identified in accordance with a cabinet-wiring diagram, which shall be furnished by the supplier. The SPTCS cabinet shall include the following:

1. Main power supply circuit breaker, as required.
2. Copper ground strip, grounded to cabinet, for connection of all common conductors.
3. Lightning Suppression for individual loops and communication system.

715.2.1.6 Solar Power Unit

Beacon Assembly (Solar Powered) consists of flasher controller, flasher with or without time clock, pole mounted cabinets, Solar panels, batteries, and battery cabinets. The assembly includes all internal wiring, conduits, and hardware or Material to make a complete and working unit in the HIBU. Additional options maybe indicated as needed. The options may include but not limited to the following:

1. Internet connectivity;
2. Modem
3. Two (2)-way radio;
4. WiFi or Alpha pager controlled;
5. GPS enabled; and
6. Battery backup.

715.2.1.6.1 Solar Flasher

The Contractor shall provide a flasher unit designed for use with solar powered systems with an alternating two output circuit (12V DC) using standard eight (8)-pin octal base. Each output rated six (6) amps – working with LED signal lamps. The Contractor shall provide flasher units in a solid state with no moving parts. Flasher units must be designed to operate at full capability in air temperatures ranging from negative thirty degrees (-30°) F to 160° F.

715.2.1.6.2 Solar Pole-Mounted Beacon Control Cabinet

The Contractor shall provide a cabinet (s) made of sturdy aluminum housing with a hinged main door equipped with a lock for a police key. The Contractor shall provide two (2) police keys with each cabinet.

The Contractor shall provide cabinet(s) as required to house the specified Equipment. The Contractor shall ensure switches and controls are accessible through the front door. The Contractor shall provide side-of-pole mounting cabinets.

Supplied for the system shall be complete with the solar panel mounted on Type I standard. The unit includes the following:

1. Solar panel;
2. Battery; and
3. Solar regulator.

The Contractor shall provide sizing report that assures the performance of the solar panels and batteries meet the required operational needs. The documentation shall address the following as a minimum:

1. Location - specific geographic location of the application site so accurate solar Radiation data can be provided. For example, the state of New Mexico is too general. The city of Santa Fe (in New Mexico) would be more specific;
2. Load - quantify the electrical load. A typical school zone flasher Project must list led lamps, a time clock and a control circuit. The Contractor shall furnish power draw of each piece of Equipment. The Contractor shall identify the lamp configuration and calculate the load's power draw; and
3. Duty cycle - the Contractor shall provide a system that addresses the number of hours per Day each piece of Equipment will be operated.

The resultant sizing report will yield the solar array size and description for the location; the required battery subsystem needed; and the estimated performance for each month of the year.

715.2.1.6.3 Modem

The Contractor shall furnish and install a low power modem for phone line or CDMA (EVDO) cellular modem, as specified by NMDOT. The modem shall report connectivity between the SPTCS and designated intermediate server.

The cellular communications modem (if chosen) must be compatible with NMDOT's current wireless carrier (Verizon).

715.2.1.6.4 Surge Protectors

The Contractor shall furnish and install surge protection for Controller Cabinet, communication and solar unit.

715.2.1.6.5 Warranty

All Equipment shall have a minimum warranty period of two (2) years from the date of Acceptance. Each warranty shall include actual parts and labor for any warranty Work performed at the manufacturer's facility.

A copy of each written warranty shall be included and submitted by the Contractor and approved by the State Traffic Technical Support Engineer or designee prior to construction of the HIBU System. The NMDOT shall be designated as the holder of each component warranty. Each warranty shall indicate the manufacturer responsible for the components of the system and contact information for the manufacturer shall be provided with each warranty.

The manufacturer shall be responsible for the replacement or repair of any system component that fails during the warranty period. Any replacement or repair of the system shall be done to the satisfaction of the Department during the warranty period.

715.2.2 Radar Feedback Unit (RFU)

The unit can be in form of LED display with attached sign or sign unit in combination with LED displays in compliance with Manual Uniform Traffic Control Devices (MUTCD) this Specification, and details specified in the Contract.

This RFU shall be easy (pole mounted or back of a public entities vehicle) to install and programmable with the capacity to display violator alerts including speed numbers and 'slow down' text into one highly visible package. The unit shall use license free radar, red-blue flashing bars or white LED flashing strobes.

Data and sign management program shall be menu driven to generate reports of speed data statistics along with the option to download raw data for comparative analysis.

Housing shall be NEMA-3 weatherproof sealed. All external components of the RFU shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration.

LED Light for display shall be high intensity latest generation AllnGp.

Characters may be available in nine (9)", 12", 15", 18" and 22" display heights, as specified.

Automatic intensity adjustment must be available for ambient light conditions.

Terminal Block and Wiring. All wiring and terminal blocks must conform to requirements set forth in section 13.02 of the ITE Publication; Equipment and Material Standards.

Mounting Assembly. The radar unit must be able to be mounted on pole or public entities' vehicle as specified in the Contract.

All light engines must fully comply with Restriction of Hazardous Substance Directive (RoHS).

715.2.2.1 Warranty, Maintenance, and Support

1. The Contractor shall obtain and assign to the Department all manufacturers guarantees or warranties which are normally provided as customary trade practice for items and materials incorporated into the Work. In the absence of a manufacturer's guarantee, the Contractor shall warrant that mechanical and electrical Equipment and Material incorporated into the work are free from any defects or imperfections in workmanship and Material for a period of one (1) year after Final Acceptance of the Project. The Contractor shall be responsible for repairing any malfunction or defect in any such Equipment or Material, which develops during the one (1) year period.
2. The Contractor shall supply two (2) sets of installation guides and user manuals for the Equipment incorporated in the Project, one (1) of which shall be submitted to the Department with submittal of manufacturers shop drawings.
3. During the warranty period, technical support by toll-free telephone shall be provided by the manufacturer 24 hours per Day, 365 days per year, and request for

support by telephone shall be answered by manufacturer personnel within one (1) hour.

4. Manufacturer must warrant to the entity in charge of the maintenance of Radar Feedback Unit that from the date of purchase and for a period of sixty (60) months for LED display and Twenty (24) months for radar equipment beyond the date of purchase that products manufactured shall be free from defects in workmanship and obscure damage to component parts of the type that might occur during one (1) year period. Manufacturer either repairs or replaces the defective device.

715.2.3 Rectangular Rapid Flashing Beacon

715.2.3.1 Beacon Assembly

Each RRFB shall consist of two (2) rectangular-shaped yellow indications, each to be at least five (5) inches wide by two (2) inches high. The rectangular indications shall be aligned horizontally with at least seven (7) inches of minimum space between the indications as measured from the nearest edge of one to the nearest edge of the other indication.

715.2.3.2 Flasher

When actuated, the two (2) yellow indications in each RRFB unit shall flash in a rapidly flashing sequence. The RRFB shall provide 75 flashing sequences per minute.

715.2.4 Span Wire Installation

The Contractor shall provide span wire consisting of a set of poles and guy wire support system over a Roadway normally used for flashing beacons. Span wire installations include poles, guy wire, down guys (if required), and miscellaneous hardware and turnbuckles.

715.2.4.1 Poles

The Contractor shall provide free-standing steel strain poles or guyed timber poles capable of supporting the span and specified attached Equipment without noticeable bending.

715.2.4.1.1 Steel Strain Poles

The Contractor shall provide steel strain poles of round or octagonal tapered steel tube that is the length specified in the Plans having a three (3) gauge wall thickness (approximately 1/4 inch or thicker), as required by the design span specified in the Contract. Steel strain poles shall be designed in accordance with the 1994 or most current AASHTO Specification utilizing an 80 mph isotach wind velocity. The Contractor shall provide steel with yield strength of 55,000 psi or greater. The Contractor shall provide strain poles that are galvanized inside and out in accordance with ASTM A 123.

715.2.4.1.2 Timber Poles

The Contractor shall provide treated timber poles in accordance with AASHTO M 133 or AWPA Standard U1, commodity Standard B: Posts.

715.2.4.1.3 Anchors

The Contractor shall design the anchor base to develop the maximum strength of the shaft. The Contractor shall provide anchor bolts that have a diameter of 1 1/2 inch, are five (5) ft long with minimum tensile strength of 85,000 psi, unless otherwise specified in the Plans.

The Contractor shall provide two (2) leveling nuts and washers for each anchor bolt.

715.2.4.1.4 Guy Strand Wire

The Contractor shall provide guy strand wire (seven (7)-wire) with an approximate weight of 273 lb per 1,000 ft and minimum breaking strength of 10,000 lb. The Contractor shall run electrical cable inside steel poles and exit the pole at the top in a weatherproof manner, for wood pole installations protect the cables with IMC conduit mounted on the poles.

715.2.4.1.5 Span Wire Signal Equipment

Equipment required for span wire signal installation shall conform to Section 706, "Signal and Lighting Service Systems;" 709, "Rigid Electrical Conduit;" 710, "Pull Boxes and Splice Cabinets;" 711, "Wiring;" 712, "Signal Assemblies;" 713, "Detectors;" and 714, "Traffic Signal Controllers."

715.3 CONSTRUCTION REQUIREMENTS

715.3.1 HBIU

The hardware and support services specified herein are intended to describe the minimum configuration that will be acceptable for a HIBU System. Any changes are subject to approval by the State Traffic Technical Support Engineer. The Contractor shall provide all drawings, schematics, Material lists, fabrication details and Specifications to the State Traffic Technical Support Engineer for approval 30 Days prior to procurement of the Equipment.

The HIBU system shall include all Incidental items, hardware, and Equipment necessary to make the HIBU system operational and complete in all respects, including all items not individually specified, and the items shall be furnished and installed without additional cost to the NMDOT.

715.3.1.1 Documentation

The Contractor shall provide manufacturer documentation for all components of the HIBU System. The documentation shall provide a complete and precise technical description of the system equipment and Materials and shall thoroughly demonstrate that the systems, including all assemblies, fully conform to all requirements of the Specifications.

The Contractor shall provide two (2) sets of electronic versions and hard copy manuals on the operation, maintenance, and troubleshooting of all system components.

715.3.1.2 Testing

The Contractor, prior to Final Acceptance, shall test the HIBU System. The Contractor shall furnish all necessary Equipment and labor required for the testing at the site.

Testing shall be performed in the presence of the Project Manager or designee. Tests shall not be performed without written approval of the Project Manager.

A complete report of each test performed shall be submitted. The report shall include all actions and results and all failures and corrective or preventive measures taken. Full compensation for performing the local operational tests as specified herein shall be considered incidental to the HIBU System and no separate payment will be made therefore.

The Contractor shall mount beacons and flasher controllers on the specified support.

715.3.2 Radar Feedback Units (RFU)

Radar Feedback Unit shall be mounted on the specified supports as called for and detailed in the Contract.

715.3.3 RECTANGULAR RAPID FLASHING BEACON

The RRFB shall provide 75 flashing sequences per minute. During each 800 millisecond flashing sequence the left and right RRFB indications shall operate using the following sequence:

1. The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds followed by a period where both RRFB indications will be dark for 50 milliseconds.
2. The RRFB indication on the right-hand side shall be illuminated for 50 milliseconds followed by a period where both RRFB indications will be dark for 50 milliseconds.
3. The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds followed by a period where both RRFB indications will be dark for 50 milliseconds.
4. The RRFB indication on the right-hand side shall be illuminated for 50 milliseconds followed by a period where both RRFB indications will be dark for 50 milliseconds.
5. Both RRFB indications shall be illuminated for approximately 50 milliseconds followed by a period where both RRFB indications shall be dark for approximately 50 milliseconds.
6. Both RRFB indications shall be illuminated for approximately 50 milliseconds followed by both RRFB indications being dark for 250 milliseconds.

The flash rate of each individual RRFB indication, as applied over the full flashing sequence, shall not be between five (5) and 30 flashes per second to avoid frequencies that might cause seizures.

The light intensity of the yellow indications during daytime conditions shall meet the minimum specifications for Class 1 yellow peak luminous intensity in the Society of Automotive Engineers (SAE) Standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005.

To minimize excessive glare during nighttime conditions and automatic signal dimming device should be used to reduce the brilliance of the RRFB indications during nighttime conditions.

715.3.4 Span Wire Installation

The Contractor shall provide span wire pole installation, including erecting poles, installing anchor bolts in a foundation, and leveling the pole. After raking, the Contractor shall place at least four (4) inches of grout between the anchor base and the top of the foundation. The Contractor shall tension the complete span wire with the specified sag.

If the Plans specify a temporary (construction related) span wire, remove Material after completion of the Work. Removed temporary span wire Material will become the property of the Contractor, unless otherwise specified in the Plans.

715.4 METHOD OF MEASUREMENT

HIBU (A/C Power Feed) will be measured using the following separate items:

1. Beacon Assembly;
2. One (1) Section Traffic Signal Assembly;
3. Type I Standard (15 feet), and foundations;
4. Panel Signs; and
5. External A/C power, meter, wiring, and conduit system.

HIBU (Solar Power Feed) will be measured using the following separate items:

1. Beacon Assembly (Solar Powered);
2. One (1) Section Traffic Signal Assembly;
3. Type I Standard (18 feet), and foundations;
4. Panel Signs.

Radar Feedback Unit (A/C Power Feed) will be measured using the following separate items in accordance with the Contract:

1. RFU Assembly;
2. Type I Standard (15 feet), and foundations;
3. Panel Signs; and
4. External A/C power, meter, wiring, and conduit system.

Radar Feedback Unit (Solar Power Feed) will be measured using the following separate items in accordance with the Contract:

1. RFU Assembly (Solar Powered);
2. Type I Standard (18 feet), and foundations; and
3. Panel Signs.

Rectangular rapid flashing beacon (A/C Power Feed) will be measured using the following separate items in accordance with the Contract:

1. RRFB Assembly;
2. Type I Standard (15 feet), and foundations;
3. Panel Signs; and
4. External A/C power, meter, wiring, and conduit system.

Rectangular rapid flashing beacon (Solar Power Feed) will be measured using the following separate items in accordance with the Contract:

1. RRFB Assembly (Solar Powered);
2. Type I Standard (18 feet), and foundations; and
3. Panel Signs.

Span wire installation will be measured by Lump Sum.

715.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Beacon Assembly</i>	Each
Solar Powered Beacon Assembly	Each

<i>Radar Feedback Unit</i>	Each
<i>Solar Powered Radar Feedback Unit</i>	Each
<i>Rectangular Rapid Flashing Beacon</i>	Each
<i>Solar Powered Rectangular Rapid Flashing Beacon</i>	Each
<i>Span Wire Installation</i>	Lump Sum

The Department will pay for Panel Signs in accordance with Section 701, "Traffic Signs and Sign Structures."

The Department will pay for One (1) Section Traffic Signal Assembly in accordance with Section 712, "Signal Assemblies."

The Department will pay for Type I Standards in accordance with Section 707, "Signal and Lighting Standards."

The Department will pay for Foundations in accordance with Section 708, "Foundations for Signal and Lighting Installations."

The Department will pay for A/C power and meter pedestals in accordance with Section 706, "Signal and Lighting Service Systems."

The Department will pay for wiring in accordance with Section 711, "Wiring."

The Department will pay for conduit in accordance with Section 709, "Rigid Electrical Conduit."

The Department will pay for Accepted span wire signal installation at the Bid Item Unit Price when it is complete, in place, and operational for the period specified.

SECTION 716: LUMINAIRES

716.1 DESCRIPTION

This Work consists of providing and installing Luminaires on Standards, Bridge Structures, or sign supports. This Work also includes lamps, drivers, ballasts, photocell control units, necessary mounting hardware, and specified wiring.

The Contractor shall install outdoor lighting in accordance with the New Mexico Night Sky Protection Act (NMSA 1978, § 74-12-1 et seq.); as detailed in the latest applicable UBC™. The Contractor shall obtain the UBC™ from the State Construction Industries Division.

716.2 MATERIALS

716.2.1 Roadway Luminaire

The Contractor shall provide horizontal-burning, Roadway Luminaires with two (2) inch slip fitters on the house side for mounting on a Type V Standard, in accordance with the Contract.

The Contractor shall provide the lamp type (LED or high-pressure sodium), lamp wattage, and line voltage in accordance with the Contract.

The Contractor shall provide power supply or ballasts pre-wired to the lamp socket (may use quick-disconnect plugs), requiring only connection to the power supply terminal block (screw type).

The Contractor shall provide a polycarbonate-type terminal block.

716.2.1.1 Glassware

The Contractor shall provide flat, borosilicate glassware.

716.2.1.2 Reflector and Socket

The Contractor shall provide anodized aluminum reflectors. The Contractor shall provide high-grade porcelain sockets with both axial and vertical adjustment.

716.2.1.3 Mounting Requirements

The Contractor shall mount the refractor in a doorframe assembly, hinged to the Luminaire at the house side, and fastened at the Street side with an automatic latch. The Contractor shall secure the reflector and lamp socket to the upper housing.

The Contractor shall ensure the refractor and doorframe assembly are forced upward at the Street side by spring pressure against a gasket seat when in the closed and latched position.

The Contractor shall provide easily removable power supply power-pack ballasts connected with quick-disconnect plugs. The Contractor shall provide a separate rear door allowing access to the ballast, not disturbing the sealed optical system. A single door allowing access to the ballast, other electrical components and the optical system is Acceptable if the ballast and other electrical components are removable with a screw driver.

The Contractor shall provide the slip fitter capable of clamping on one (1) inch or two

(2) inch pipe brackets without removing the clamping device. Also, the Contractor shall provide the slip fitter capable of leveling of the Luminaire horizontally \pm three degrees (3°).

The Contractor shall provide gaskets of a breathing Material capable of filtering and sealing the fixture, capable of withstanding the temperatures created by the Luminaire. The Contractor shall secure the gaskets in place.

The Contractor shall provide die-cast aluminum housings and refractor rings. The Contractor shall provide latch and exposed hinge parts of a non-corrosive Material.

If on a Bridge deck, the Contractor shall mount poles on vibration-dampening pads. The Contractor shall provide fixtures with lamp stabilizers to reduce the potential for damage from vibration, and certified to withstand a 3G-vibration test.

716.2.1.4 Photocell Controller

If specified, The Contractor shall provide an individual photocell controller on the top of the housing, mounted inside, or outside. The Contractor shall provide a polycarbonate photo-control receptacle.

716.2.1.5 LED Luminaire

The publications listed below form a part of this Specification to the extent referenced. Versions listed shall be superseded by updated versions as they become available.

- A. American National Standards Institute (ANSI):
 - 1. C136.2-2004 (or latest), American National Standard for Roadway and Area Lighting Equipment—Luminaire Voltage Classification;
 - 2. C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photo control Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing;
 - 3. C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification;
 - 4. C136.22-2004 (R2009 or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires;
 - 5. C136.25-2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures;
 - 6. C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration; and
 - 7. C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting.
- B. Illuminating Engineering Society of North America (IESNA or IES):
 - 1. DG-4-03 (or latest), Design Guide for Roadway Lighting Maintenance;
 - 2. HB-10-11 (or latest), IES Lighting Handbook, 10th Edition;
 - 3. LM-50-99 (or latest), IESNA Guide for Photometric Measurement of Roadway Lighting Installations;
 - 4. LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products;
 - 5. LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance

- of LED Light Sources;
6. RP-8-00 (or latest), ANSI / IESNA American National Standard Practice for Roadway Lighting;
 7. TM-3-95 (or latest), A Discussion of Appendix E - "Classification of Luminaire Lighting Distribution," from ANSI/IESNA RP-8-83;
 8. TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires; and
 9. TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light Sources.
- C. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE C62.41.2-2002 (or latest), IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; and
 2. ANSI/IEEE C62.45-2002 (or latest), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Manufacturers Association (NEMA):
1. ANSI/NEMA/ANSLG C78.377-2008 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products.
- E. National Fire Protection Association (NFPA):
1. 70 – National Electrical Code (NEC).
- F. Underwriters Laboratories (UL):
1. 1449, Surge Protective Devices;
 2. 1598, Luminaires; and
 3. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Product.

716.2.1.5.1 Roadway Luminaire

The Contractor shall provide Roadway Luminaire consisting of a housing, LED light source, photo-control device (if specified) and electronic driver (power supply). The power supply shall be integral to the unit.

The Contractor shall provide the LED light source, lamp wattage, and line voltage in accordance with the Contract.

The Contractor shall provide a two (2) inch slipfitter able to be mounted on the NMDOT Type V standard without any addition external hardware.

The Contractor shall provide Luminaire capable of operating in a temperature range of negative forty degrees (-40°) C to 40° C (approximately -40° F to 104° F).

The Contractor shall provide Luminaire with ANSI C136.41 photo-control receptacle for future upgrading if required by Contract.

Luminaire shall be compliant with UL 1598 and suitable for use in wet conditions. Each Luminaire shall have an IEC 529 Ingress Protection rating of IP 66 or greater. Lumen maintenance shall be measured in accordance with IESNA LM-80 and long-term lumen maintenance shall be measured in accordance with IESNA TM-21.

Luminaire light source and drivers shall be Restriction of Hazardous Substance Directive (RoHS) compliant.

Luminaire shall be constructed such that LED modules may be replaced or repaired

without replacement of whole Luminaire. All needed electrical and electronic components shall have quick-disconnect type connectors.

716.2.1.5.2 Mounting Requirements

The Contractor shall provide heavy-duty cast aluminum housing. Housing shall be designed to allow water shedding. All hardware on the exterior of the housing, including cover, latch, and exposed hinge parts shall be of a non-corrosive Material such as stainless steel, zinc or steel with zinc alloy electroplate and chromate top coat. Exterior painting for additional corrosion resistance shall be as specified in the Contract.

The Contractor shall provide housing that is easy to open when mounted or when placed on the ground. All internal parts shall be readily accessible.

The Contractor shall provide gaskets capable of filtering and sealing the fixture, and capable of withstanding the temperatures created by the Luminaire.

The Contractor shall provide a two (2)-bolt or four (4)-bolt slipfitter mount capable of clamping on a nominal two (2) inch pipe tenon. Slipfitter mount shall allow a minimum of four (4) inches of the pole bracket to be inserted into the Luminaire mounting assembly. The slipfitter mount shall be capable of leveling the Luminaire horizontally \pm three degrees (3°).

The Contractor shall provide easy removable drivers with quick-disconnect plugs and which will not disturb the sealed optical system. A single door allowing access to the electrical components and the optical system is Acceptable if the electrical components are easily removable with a screwdriver.

The Contractor shall provide an external label stating operating voltage and current range per ANSI C136.15. The Contractor shall provide an internal label per ANSI C136.22.

The Contractor shall provide Luminaire designed to withstand mechanical shock and vibration from high winds and other sources. Luminaires shall be certified to withstand a 2G vibration test as determined by IEEE C136.31. Luminaires to be located on a Bridge deck shall be certified to withstand a 3G vibration test as determined by IEEE C136.31.

The Contractor shall provide Luminaire ingress protection in accordance with ANSI C136.25.

716.2.1.5.3 Photometric Requirements

The Contractor shall provide a completely sealed optical system with an (IEC) IP rating of 66 or greater. Testing shall be in accordance with IESNA LM-79 and at an ambient temperature of 25° C.

The Contractor shall provide a nominal corrected color temperature (CCT) range of 4000K to 4500K in accordance with NEMA C78.377. The color rendering index (CRI) shall be 70 or greater.

The Contractor shall provide Luminaire with a Backlight, Uplight and Glare (BUG) rating (calculated per IESNA TM-15) as follows:

1. Backlight rating shall not exceed three (3);
2. Uplight rating shall not exceed zero (0); and
3. Glare rating shall not exceed three (3).

The Contractor shall provide Luminaire with a minimum efficacy of 80 lumens per watt. The Luminaire shall provide a rated life of 70,000 hours when operated at 77°F (25°C) for 12 hours per Day. The Luminaire shall deliver a minimum of 70% of initial delivered lumens after 70,000 hours of operation. The Contractor shall provide a TM-21 calculation and lumen depreciation factor calculated at 25°C at 70,000 hours upon request.

The Contractor shall provide Luminaire with over optical elements capable of providing IESNA Type II, III, IV, or V distributions as specified. All LED's shall provide the same optical pattern such that catastrophic failures of individual LED's will not constitute loss in the distribution pattern. If specified in the Contract, the Contractor shall submit photometric data in IES format to the Project Manager for approval.

716.2.1.5.4 Electrical Requirements

The Contractor shall provide Luminaire capable of operating from a 60 HZ \pm 3 HZ AC line over a voltage ranging from 110 VAC to 480 VAC. Fluctuations of line voltage shall have no visible effect on the luminous output.

The Contractor shall provide Luminaire electrical components with a lifetime rating of 70,000 hours or greater. The Contractor shall provide a minimum rated drive life of 70,000 hours.

The Contractor shall provide Luminaire with a Power Factor (PF) of 0.90 or greater and less than 20% Total Harmonic Distortion (THD) under full load.

The Contractor shall provide Luminaire with integral surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall conform to UL 1449 and performance shall be tested in accordance with IEEE C62.41 (Class C) and IEEE C62.41. The SPD shall be field replaceable.

The Contractor shall provide Luminaire with thermal management of sufficient capacity to assure proper operation over the expected useful life.

716.2.1.5.5 Photo-control Device

The Contractor shall provide Luminaire with an individual photo-control device on the top of the housing, mounted inside or outside, if specified in the Contract. The photo-control device shall meet ANSI C136.10 standards.

716.2.1.5.6 WARRANTY

1. The entire Luminaire assembly including Materials, workmanship, photometrics, labor, power supply and LED modules shall have a minimum five (5) year warranty from the date of Acceptance.
2. If more than five percent (5%) of the individual LED's fail within the warranty period the Luminaire must be repaired or replaced.
3. The warranty will not be affected by opening the power door and/or accessing the electrical cavity.
4. The specified paint finish shall have a minimum five (5) year warranty from the date of Acceptance.

716.2.2 High-Mast Luminaire (Non LED)

The Contractor shall provide area, vertical-burning type, high-mast Luminaires for mounting above 60 ft. The Contractor shall use Luminaires consisting of weatherproof cast aluminum or formed aluminum ballast housing, a cast aluminum slip fitter frame, and a bell-shaped optical assembly. The Contractor shall ensure that the lamp type, lamp wattage, and line voltage are in accordance with the Contract.

The Contractor shall ensure the slip fitter accepts a two (2) inch bracket and is adjustable three degrees (3°) up or down. The Contractor shall provide a pre-wired terminal board to accommodate from No. 6 to No. 14 AWG wire. The Contractor shall provide a mogul multiple pre-wired, porcelain enclosed lamp socket with integral lamp grip that is adjustable to control the angle of maximum lumens.

The Contractor shall provide anodized, aluminum reflectors.

The Contractor shall submit photometric data to the Project Manager for approval.

The Contractor shall provide an optical assembly that allows mounting of an external shield, if necessary.

Unless otherwise specified, the Contractor shall provide open, ventilated optical assemblies. If required, the Contractor shall provide borosilicate glass for the bottom of the assembly.

If the Contract specifies a closed type, the Contractor shall provide an optical assembly with a heat and shock-resistant glass flat lens on the bottom with a silicone rubber gasket. The Contractor shall provide gaskets of a breathing Material capable of filtering and sealing the fixture, capable of withstanding the temperatures created by the Luminaire.

The Contractor shall provide a ballast, easily removable from the top of the Luminaire, using bolts or latches and quick-disconnect electrical leads.

The Contractor shall ensure exposed parts are of a non-corrosive Material.

716.2.3 LED High Mast Luminaire

The Contractor shall provide vertical-burning High Mast Luminaires for mounting above 60 feet. High Mast Luminaires shall consist of a weatherproof aluminum housing, an aluminum slipfitter, LED light source, photo-control device (if specified) and electronic driver (power supply).

The Contractor shall provide the LED light source, lamp wattage, and line voltage in accordance with the Contract.

The Contractor shall provide Luminaire capable of operating in a temperature range of negative forty degree (-40°) C to 45° C (approximately -40° F to 115° F).

The Contractor shall provide mount capable of securely attaching the assembly while providing ± three degrees (3°) of vertical adjustment.

The Contractor shall provide open, ventilated optical assemblies unless otherwise specified. If the Contract specifies a closed assembly, the Contractor shall provide an optical assembly with a heat and shock-resistant glass flat lens on the bottom with a gasket capable of filtering and sealing the fixture while withstanding the temperatures created by the Luminaire.

The Contractor shall provide non-corrosive materials for all exposed parts on the exterior of the housing, including covers, latches, and exposed hinge parts.

The Contractor shall provide High Mast Luminaire compliant with UL 1598 and suitable for use in wet conditions.

The Contractor shall provide easy quick-disconnect plugs and easy access to LED drivers, surge protection, and terminal block.

The Contractor shall provide High Mast Luminaire designed to withstand mechanical shock and vibration from high winds and other sources. High Mast Luminaires shall be certified to withstand a 3G vibration test as determined by IEEE C136.31.

The Contractor shall provide Luminaire electrical components with a lifetime rating of 100,000 hours or greater.

The Contractor shall provide High Mast Luminaire with a Power Factor (PF) of 0.90 or greater and less than 20% Total Harmonic Distortion (THD) under full load.

The Contractor shall provide Luminaire with integral surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall conform to UL 1449 and performance shall be tested in accordance with IEEE C62.41 (Class C) and IEEE C62.41. The SPD shall be field replaceable.

The Contractor shall provide High Mast Luminaire with a minimum efficacy of 80 lumens per watt.

The Contractor shall provide a nominal corrected color temperature (CCT) range of 4,000K to 5,000K in accordance with NEMA C78.377. The color rendering index (CRI) shall be 70 or greater.

The Contractor shall provide a symmetrical light distribution with IESNA Type V FCO (full cut-off). If the Contract specifies asymmetrical light distribution, the Contractor shall provide IESNA Type II or III (FCO) or as otherwise specified in the Contract.

The Contractor shall provide photometric data in IES format to the Project Manager for approval if specified in the Contract.

716.2.4 Area Luminaire and Ornamental Luminaires

The Contractor shall provide Area and Ornamental Luminaires that are decorative Luminaires mounted on Type V Standards or ornamental poles for rest areas or similar applications. Area and Ornamental Luminaires shall consist of a weatherproof aluminum housing, an aluminum slipfitter, LED light source, photo-control device (if specified) and electronic driver (power supply).

The Contractor shall provide the LED light source, lamp wattage, and line voltage in accordance with the Contract.

The Contractor shall provide non-corrosive materials for all exposed parts on the exterior of the housing, including covers, latches, and exposed hinge parts.

The Contractor shall provide Area and Ornamental Luminaire compliant with UL 1598 and suitable for use in wet conditions.

The Contractor shall provide easy quick-disconnect plugs and easy access to LED drivers, surge protection, and terminal block.

The Contractor shall provide Luminaire electrical components with a lifetime rating of 70,000 hours or greater.

The Contractor shall provide Area and Ornamental Luminaire with a Power Factor (PF) of 0.90 or greater and less than 20% Total Harmonic Distortion (THD) under full load.

The Contractor shall provide Luminaire with integral surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall conform to UL 1449 and performance shall be tested in accordance with IEEE C62.41 (Class C) and IEEE C62.41. The SPD shall be field replaceable.

The Contractor shall provide Area and Ornamental Luminaire with a minimum efficacy of 80 lumens per watt.

The Contractor shall provide a nominal corrected color temperature (CCT) range of 4,000K to 5,000K in accordance with NEMA C78.377. The color rendering index (CRI) shall be 70 or greater.

The Contractor shall provide a symmetrical light distribution unless otherwise specified in the Contract.

The Contractor shall provide photometric data in IES format to the Project Manager for approval if specified in the Contract.

716.2.5 Underpass Luminaire

The Contractor shall provide Underpass Luminaires that consist of a weatherproof aluminum housing, mounting hardware, LED light source, and an electronic driver (power supply).

The Contractor shall provide the LED light source, lamp wattage, and line voltage in accordance with the Contract.

The Contractor shall provide Underpass Luminaires that mount directly on a wall with surface wiring or over a recessed outlet box.

The Contractor shall provide Luminaire capable of operating in a temperature range of negative forty degree (-40°) C to 45° C (approximately -40° F to 115° F).

The Contractor shall provide non-corrosive Materials for all exposed parts on the exterior of the housing and tamper-resistant latches.

The Contractor shall provide Underpass Luminaire designed to withstand mechanical shock and vibration from vehicular traffic and other sources. Underpass Luminaires shall be certified to withstand a 3G vibration test as determined by IEEE C136.31.

The Contractor shall provide Luminaire with integral surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall conform to UL 1449 and performance shall be tested in accordance with IEEE C62.41 (Class C) and IEEE C62.41. The SPD shall be field

replaceable.

The Contractor shall provide a nominal corrected color temperature (CCT) range of 3,500K to 4,500K in accordance with NEMA C78.377. The color rendering index (CRI) shall be 70 or greater.

The Contractor shall provide Luminaires capable of illuminating an area equal to one (1) mounting height on either side of the fixture, and two (2) mounting heights in front of the fixture.

716.2.6 Ballasts

The Contractor shall provide ballasts for high-intensity discharge lamps for the primary current and types of lamps, as specified. Unless otherwise specified, the ballast shall be an integral part of the Luminaire. The Contractor shall provide ballasts that are in accordance with the appropriate ANSI Standard (see Table 716.2.7.1, "High-Intensity Discharge Lamp/Ballast Requirements.").

716.2.6.2 High-Pressure Sodium Ballasts

The Contractor shall provide ballasts with isolated primary and secondary windings for 250 W and 400 W high-pressure sodium lamps, and a transient impulse level of 10 kV, voltage input range of \pm ten percent (10%), and ballast loss of no more than ten percent (10%).

If using integrated circuit design ballast, the Contractor shall provide isolated primary and secondary lamp circuit windings and transient impulse level of 10 kV.

The Contractor shall provide constant wattage auto-regulation type ballasts for 1,000 W high-pressure sodium lamps. The Contractor shall use ballasts having a transient impulse level of 7.5 kV, a voltage input range of \pm ten percent (10%), and a ballast wattage loss of no greater than ten percent (10%).

716.2.7 Fixtures

The Contractor shall provide LED or HID lamps for Luminaires in conformance with the requirements shown in the Contract. The Contractor shall submit product Specifications to the Project Manager for Acceptance three (3) weeks prior to ordering fixtures.

716.3 CONSTRUCTION REQUIREMENTS

The Contractor shall properly align and level Luminaires in accordance with the manufacturer's and Contract design requirements. Include three (3) single conductors, No. 10 or as specified, to the Standard pole base, or to the nearest splice point into main distribution feed, for the installation of Luminaires.

The Contractor shall properly assemble, level, and align LED Luminaire in accordance with manufacturer's and Contract design requirements.

The Contractor shall provide conduit and wiring to the nearest pull box (splice point into the main distribution feed) and necessary mounting devices for the installation of underpass Luminaires.

The Contractor shall place ornamental poles and Luminaires in accordance with the Contract requirements and the manufacturer's recommendations, as approved by the Project Manager.

716.4 METHOD OF MEASUREMENT

Roadway luminaires (Non LED) will be measured on a per unit basis.

LED Luminaires will be measured on a per unit basis.

LED Luminaires will be paid for at the contracted unit price per each unit.

716.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Roadway Luminaire Type</i> _____	Each
<i>Area Luminaire Type</i> _____	Each
<i>Underpass Luminaire</i>	Each
<i>High Mast Luminaire Type</i> _____	Each
<i>Ornamental Pole and Luminaire</i>	Each
<i>LED Roadway Luminaire</i>	Each
<i>LED High Mast Luminaire</i>	Each
<i>LED Underpass Luminaire</i>	Each
<i>LED Area Luminaire</i>	Each
<i>LED Ornamental Luminaire</i>	Each

The Department will specify the Luminaire type by lamp watts and lamp type abbreviations as follows:

1. M—LED-Lighting ; and
2. S—Sodium;
 - a. Example: Type 400S specifies a Luminaire with a 400-watt high-pressure sodium lamp.

716.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Wiring;
2. Conduit;
3. Mounting hardware and ballast; and
4. Photo-control units.

SECTION 720: VEHICULAR IMPACT ATTENUATOR UNITS and SAND BARREL IMPACT ATTENUATOR UNITS

720.1 DESCRIPTION

This Work consists of providing and installing vehicular impact attenuator units, and sand barrel impact attenuator units.

720.2 MATERIALS

The Contractor shall provide Materials from the Department's Approved Products List for vehicular impact attenuator units, which the Contractor may obtain from the State Maintenance Bureau. The Contractor shall use Materials of the manufacturer's latest approved design. The Contractor shall use Materials of a uniform type and from a single manufacturer. The Contractor shall not mix component parts.

Suppliers of vehicular impact attenuator units proposed for including on the Department's *Approved Products List* shall submit certification for approval to the Traffic Services Engineer. The certification shall be a signed and notarized statement prepared by the manufacturer stating that the Materials proposed for use have met the testing requirements in accordance with NCHRP *Report 350 and/or MASH*.

The Contractor shall submit manufacturers' certificates, literature, and shop drawings to the Project Manager for approval before fabrication and installation of the units.

The Contractor shall provide Class A concrete, if required by the Contract for foundations and anchors, in accordance with Section 510, "Portland Cement Concrete."

The Contractor shall provide reinforcing steel in accordance with Section 540, "Steel Reinforcement."

720.2.1 Vehicular Impact Attenuator Units

720.2.1.1 Manufacturer Identification and Marking

The Contractor shall provide vehicular impact attenuator units identifying the type of unit permanently stamped on each unit. The permanent stamp shall correspond with those shown on the shop drawings.

720.2.2 Sand Barrel Impact Attenuators

The Contractor shall install sand barrel impact attenuators in accordance with the manufacturer's recommendations and the traffic control Plan.

720.2.2.1 Color

The Contractor shall provide yellow modules for sand barrel vehicular impact attenuators, unless otherwise specified.

720.2.2.2 Sand

The Contractor shall provide well-graded, dry aggregate for filling ballast attenuator barrels. The Contractor shall provide sand in accordance with gradation limits of AASHTO M 6, unless otherwise specified on the Plans or as recommended by the manufacturer. The Contractor shall ensure the moisture content of the sand does not exceed

three percent (3%).

720.2.2.3 Foundation Pads

The Contractor shall place sand barrels in accordance with the following:

1. On pallets of wood or wood composite construction that are not more than four (4) inches high. Ensure the lateral dimensions of the pallets are large enough to allow spacing and configuration of the sand barrels in accordance with the manufacturer's recommendations.
2. On a hard, dense, and level surface no more than four (4) inches above adjacent Roadway grade; or
3. As otherwise recommended by the manufacturer.

720.2.3 Reflective Sheeting

The Contractor shall provide the sheeting in accordance with Section 701, "Traffic Signs and Sign Structures."

720.3 CONSTRUCTION REQUIREMENTS

The Contractor shall fabricate, assemble, and install vehicular impact attenuators in accordance with the manufacturer's recommendations and the approved shop drawings.

If in-place components of impact attenuators are damaged by traffic before Acceptance, the Contractor shall immediately repair or replace damaged impact attenuators.

The Contractor shall obtain on-site assistance from the manufacturer during installation, unless the Contractor can prove previous experience with the installation of vehicular impact attenuator units. The Contractor shall ensure a manufacturer's representative is present for final Acceptance of the vehicular impact attenuator unit installation, as directed by the Project Manager.

720.3.1 Sand Barrel Impact Attenuator

One (1) sand barrel impact attenuator unit consists of the number of sand-filled barrels, as recommended by the manufacturer.

If using pallets, the Contractor shall place no more than two (2) sand barrels on each pallet.

Unless otherwise specified, sand barrel impact attenuators shall remain the property of the Contractor.

720.4 METHOD OF MEASUREMENT—Reserved

720.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Permanent Vehicular Impact Attenuator Unit</i>	Each
<i>Vehicular Impact Attenuator Unit Work Zones</i>	Each
<i>Sand Barrel Vehicular Impact Attenuator Unit</i>	Each
<i>Remove/Reset Impact Attenuator Unit</i>	Each

720.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Hardware;
2. Pallets;
3. Sand;
4. Concrete;
5. Reinforcing steel;
6. Bolts;
7. Cables;
8. Steel plates;
9. Foundation Materials; and
10. Foundation preparation.

SECTION 721: PAVEMENT MARKING REMOVAL

721.1 DESCRIPTION

This Work consists of providing labor and Equipment for removal of linear markings, cross walks, stop bars, legends and symbols as well as removal of curing compound on new concrete Roadway surfaces as specified in the Contract or as directed by the Project Manager.

721.2 MATERIALS—Reserved

721.3 CONSTRUCTION REQUIREMENTS

Pavement markings shall be removed from the pavement to the maximum extent possible by method of water blasting that does not Materially alter or damage the surface, to the satisfaction of the Project Manager. Operations that do not produce the desired result, damage the pavement, or may constitute a hazard to the traveling public will not be permitted. Materials deposited on the pavement as a result of removal of pavement markings shall be promptly removed so as not to interfere with traffic or Roadway drainage.

Pavement markings designated to be removed, shall be removed before any change is made in new traffic patterns. Temporary markings conflicting with permanent pavement markings shall be removed prior to placement of the permanent pavement markings. All temporary recording shall be removed on sections where these markings conflicts with revised traffic lanes prior to opening of new lanes to traffic.

New concrete pavement surfaces that have curing compound on them, and require new pavement markings, shall be cleaned as per pavement markings manufactures recommendations for surface preparation. A dustless-abrasive shot blasting, water blasting, or other approved cleaning method may be used. The removal process shall remove all curing compound and its residue, all loose dust and dirt from the areas where primer and or new pavement markings are to be installed.

The Contractor shall remove temporary pavement stripes and markings when the Project Manager determines that they are no longer required for traffic control. The Contractor shall not use non-reflective black removable marking tape or paint to obliterate temporary pavement markings.

The Contractor shall provide the necessary personnel and Equipment to warn and divert traffic during installation and removal of temporary markings from the area where the Work is in progress.

The Contractor shall remove and dispose of debris as directed by the Project Manager.

721.4 METHOD OF MEASUREMENT

The Department will measure removal of pavement markings or remove of curing compound by four (4) inch, six (6) inch, eight (8) inch, twelve (12) inch, and twenty-four (24) inch widths per linear foot. Legends, symbols, and specialty markings will be paid by each.

721.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Removal of Pavement Marking</i>	Foot

<i>Removal of Pavement Marking Symbol</i>	Each
<i>Removal of Curing Compound for markings</i>	Foot
<i>Removal of Curing Compound for Symbol</i>	Each

721.5.1 Work Included in Payment

The following Work and items will be considered as included in the payment for the main items and will not be measured or paid for separately:

1. Repair of damaged pavement; and
2. Providing the necessary personnel and equipment to warn and divert traffic during installation and removal of temporary markings.

DIVISION 800 – CONSTRUCTION STAKING, POST CONSTRUCTION PLANS, AND SCHEDULE

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SECTION 801: CONSTRUCTION STAKING BY THE CONTRACTOR

801.1 DESCRIPTION

801.1.1 General

This Work consists of construction staking, essential for the control and completion of the Project.

801.1.2 Department-Supplied Documents and Services

The Department will provide the Contractor with survey data sufficient to layout, control, and complete the Project (this data may not be required for some book Projects). Survey data includes, but is not limited to, the following:

1. Location notes;
2. Design grades;
3. Elevations;
4. Slopes;
5. Projected locations of slope stake catch points; and
6. Lines and grades.

The Department will supply the data as printout sheets, field books, electronic pdf files (when available, and at the discretion of the Department), Right of Way maps, or Plans. The Contractor shall locate and verify required data points.

801.1.3 Contractor-Supplied Personnel & Services

The Contractor shall provide qualified personnel who are experienced in Highway construction staking to perform the staking. Per NMSA 61-23-27.13, Surveying Public Work. A New Mexico licensed professional surveyor is required to be in responsible charge of construction staking surveys for the construction of any public Work involving surveying.

The Contractor shall locate and establish control points with the data given in the Plans.

The Contractor shall verify Department-provided survey data, and submit changes or adjustments (including recorded data) to the PM for approval at no cost to the Department.

801.2 MATERIALS—Reserved

801.3 CONSTRUCTION REQUIREMENTS

801.3.1 General

The Contractor shall not disturb, cover, or remove reference marks without providing written documentation of the disturbed, covered, or removed reference mark to the Project Manager for approval. The Contractor shall reference marks include the following:

1. Triangulation stations;
2. Benchmarks;
3. Corner;
4. Monuments;
5. Stake;

6. Witness marks; or
7. Other reference marks located within the construction limits (including the limits of Temporary Construction Permits) or on the Right of Way line of this Project.

The Contractor shall coordinate the reestablishment of removed or destroyed markers with the Department. When directed, the Contractor shall reset destroyed reference markers, at no additional cost to the Department, in accordance with 61-23-28 NMSA, reference marks; removal or obliteration; replacement, and 12.8.2 NMAC, *Minimum Standards for Surveying in New Mexico* and the *Geodetic Mark Preservation Guidebook*, as prepared by the National Geodetic Survey.

The Contractor shall submit notes regarding the referencing of monuments to the Project Manager.

The Department will charge the Contractor \$1,000 for each monument the Contractor improperly referenced before disturbing, covering, or removing.

801.3.2 Construction Staking Documentation

The Contractor shall complete construction staking field notes and other documentation in accordance with the Department's current *NMDOT Survey Handbook* and accepted industry methods achieving required accuracy.

The Contractor shall keep field notes in a standard field notebook in a clear, orderly, and neat manner, consistent with professional surveying practices, unless stated otherwise in the Contract.

Construction staking documentation will become the property of the Department when the Work is complete. The Contractor shall provide construction staking documentation to the Project Manager. The Contractor shall submit earthwork quantities, slope staking, surface extracted cross sections, and earthwork calculations to the Project Manager for review before completing that phase of the Work. The Contractor shall ensure a New Mexico licensed professional surveyor or professional Engineer stamps and certifies the quantities and all submittals. The Department will not Accept earthwork quantities until the Project Manager receives all necessary survey data and reviews and approves these quantities.

The Contractor shall submit earthwork quantity information in hard copy using double-end area or prismatic computations, or using Department-approved computer software.

801.3.3 Control Points

The Contractor shall use the reference control points provided by the Department or set by the Contractor's personnel to establish construction staking points and to layout and control the Work.

The Contractor shall notify the Project Manager of errors and omissions discovered in the control points before beginning affected Work.

The Contractor shall move and re-establish benchmarks, control points, or monuments belonging to agencies of the United States, State, or local governments in accordance with the accepted procedures of the respective agency. If the Project Manager directs the Contractor to perform this Work, the Department will, unless due to Contractor operations or if detailed in the Contract, pay in accordance with Section 104.4, "Extra Work."

The Contractor shall preserve and reference the provided survey control points in such a manner, that their location can be reestablished by the Contractor in cases of weather related disturbances or vandalism.

The Contractor shall perform necessary transformation/calibration utilizing the referenced control points provided by the Department so that all survey Work is in the coordinate system provided by the DOT.

801.3.4 Accuracy Requirements

The Contractor shall meet accuracy requirements dictated by the individual elements of the Work.

801.3.5 Accuracy Verification

The Project Manager will spot check the accuracy of the construction stakes, lines, grades, and layouts but will assume no responsibility for the accuracy or the final result. The Project Manager will inform the Contractor of discrepancies immediately.

801.3.6 Non-Specified Re-staking and Re-establishment of Control

The Contractor shall perform re-staking due to the following conditions, at no additional cost to the Department:

1. Errors or omissions by Contractor personnel, or
2. The Contractor's negligence.

The Department will review re-staking in accordance with Section 104.2, "Significant Changes in the Character of Work," Section 104.3, "Differing Site Conditions," and Section 104.4, "Extra Work" when due to the following conditions:

1. Resulting from errors or omissions by the Department;
2. At the Department's request, or
3. Circumstances beyond the Contractor's control.

801.3.7 Construction Staking

801.3.7.1 Locations and Elevations

The Contractor shall verify locations and elevations of control points and benchmarks provided; establish as necessary.

801.3.7.2 Centerline

The Contractor shall establish necessary construction centerline Project stationing and reference stakes for use in setting the grade and finishing stakes, and re-establishing the construction centerline. The Contractor shall establish necessary Right of Way centerline Project stationing and reference stakes for use in determining the location of the Right of Way for construction staking purposes, and re-establishing the Right of Way centerline.

801.3.7.3 Slope Stakes, Initial Ground Topographic Survey, and Clearing Stakes

The Contractor shall set slope stakes, and stationing at intervals no greater than 100 ft. The Contractor shall perform initial ground topographic survey before beginning construction.

801.3.7.4 Grade Finishing Stakes

The Contractor shall set grade finishing stakes (blue tops) to establish grade elevations and horizontal alignment at the top of Subgrade, top of Base Course, and top of Subbase. The Contractor shall set the finish stakes at intervals no more than 50 ft. If the Contractor uses automatic grade Equipment, the Contractor shall provide Equipment Specifications that will allow interval adjustments as per manufactures recommendation.

801.3.7.5 Drainage Structures

The Contractor shall survey and plot drainage Structure locations and prepare Structure drawings to verify the accuracy of the Structure sections shown on the Plans. The Contractor shall submit the plotted drainage Structure profiles, along with a revised Structure list, to the Project Manager for review and Acceptance prior to drainage Structure construction.

801.3.7.6 Bridges

The Contractor shall perform all Bridge staking using the vertical and horizontal control points provided by the Department. The Contractor shall stake, plot, and submit a Profile Grade for the Roadway approaches, departures, approach slabs, and Bridges. The Contractor shall identify any necessary adjustments before submitting to the Project Manager.

801.3.7.7 Sign Structures

The Contractor shall stake all new sign locations. The Contractor shall stake and plot locations for extruded and overhead sign Structures. The Contractor shall submit the plotted profile to the Project Manager for Acceptance before submitting shop drawings for extruded and overhead sign Structures, and before ordering the Materials.

801.3.7.8 Slope Stake Changes

The Contractor shall perform routine slope stake changes as needed to blend slopes into the existing terrain as approved by the Project Manager.

The Contractor shall perform slope stake changes required to blend slopes into the existing terrain as approved by the Project Manager for additional Work as defined per Section 104.2, "Significant Changes in the Character of Work," Section 104.3, "Differing Site Conditions," and Section 104.4, "Extra Work."

801.3.7.9 Curbs and Gutters

The Contractor shall perform staking using vertical and horizontal control points provided by the Department.

801.3.7.10 Miscellaneous Staking

The Contractor shall perform miscellaneous staking using vertical and horizontal control points provided by the Department. Miscellaneous staking includes staking for the following:

1. Material and Borrow Pits required for contract payment;
2. Guardrails;
3. Riprap,
4. Construction signs;
5. Delineators;

6. Pavement markings;
7. Cattle guards;
8. Turnouts;
9. Ditches;
10. Fences;
11. Traffic control devices;
12. Permanent and major signs; and
13. Other miscellaneous Work the Project Manager deems necessary to properly control the Work.

801.3.7.11 Other Staking Changes

The Contractor shall perform unexpected Work and construction staking changes as directed by the Project Manager necessary for the completion of the Work.

801.3.7.12 Fence Station Markers

The Contractor shall provide a shop-made station marker every fifth station. The marker shall be one (1) inch x five (5) inch x 14 inch black on white with three (3) inch stenciled numbers. The Contractor shall mount the markers on the fence or on an appropriate shop-made post four (4) feet above the ground.

801.3.8 Removal and Disposal of Stakes

After Project completion and before final Acceptance, the Contractor shall remove and dispose of stakes and markers.

801.4 METHOD OF MEASUREMENT

The Contractor shall submit a construction staking schedule of values as part of CPM or monthly progress schedule to the Project Manager for approval.

801.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Construction Staking by the Contractor</i>	Lump Sum

The Department will make partial payments in accordance with the approved construction staking schedule of values. The Department considers slope stake changes and other staking changes as incidental to the completion of the Work and will not measure or pay for it separately.

801.5.1 Work Included in Payment

The Department will consider as included in the payment for the pay item(s) listed in this section and will not measure or pay separately for the following Work:

1. Slope stake changes; and
2. Other staking changes.

SECTION 802: POST CONSTRUCTION PLANS

802.1 DESCRIPTION

802.1.1 General

This Work consists of providing Post Construction Plans to show in detail increases or decreases in quantities and alterations in the details of the Plans, including but not limited to alterations in the grade or alignment of the Road, structures, or both. Post Construction Plans shall be kept current and readily available at all times for the Project Manager to review.

The Post Construction Plans, including any revised Plan sheets, shall be neat, legible and of the size let. All revisions to the original Plans shall be delineated in black ink, located properly on the drawing, legible and true to scale. Every Post Construction Plan, Profile, and Cross Section Sheet shall be designated as such by note or stamp "As-Built" in the upper right area in black.

802.1.1.1 Contractor-Supplied Documents and Services

The Contractor shall provide qualified personnel to perform Post Construction Plan updates and submittal in a professional, timely and accurate manner. The Contractor shall ensure the personnel supervising the operation are knowledgeable and experienced in surveying and mapping of Post Construction Plans.

If the Contractor has been given electronic data for surveying/construction staking, the submittal will be required to be both electronic & paper copy. If there is no electronic data submitted for survey, the Post Construction Plans will be paper copy submittals. All paper copy submittals shall be 24 inch x 36 inch in size unless otherwise specified by the Project Manager.

802.2 MATERIALS—Reserved

802.3 CONSTRUCTION REQUIREMENTS

802.3.1 General

The Post Construction Plan submittal shall include but not be limited to the following:

1. Changes to the length of Project in miles;
2. Changes to the B.O.P. and E.O.P. in stationing and milepost location;
3. Changes to the station equations; all equations shall be listed;
4. All Structures, as built, and changes to Major Structures with Structure Number and span length, shall be shown on the Plan and profile sheets and Structure sheets;
5. Typical section changes and station to station locations, including subexcavation limits, cut and fill limits, with the in place depth of each type of surfacing (subexcavation, Subbase, Base Course, HMA, etc.) on each Plan and profile sheet;
6. Final quantities in appropriate columns on the Plan set;
7. Changes to widths and locations of turnouts and Median openings, with radii indicated and changes to Structures, on Plan and Profile sheets;
8. All line, grade, and super elevation rate changes on Plan and profile sheets, and Structure location sheets;
9. All fencing, gates, and cattle guards remaining and built, on the *Structure Quantity Sheets*. Specify types of fencing and width of gate(s) and cattle guard(s);

10. Relocation and clearance of utility lines on utility sheets including casings, offsets, depths, or elevations. Service lines to private property are not required;
11. Bridges: All changes shall be shown on Structure location sheets and detail sheets. Show the top elevation of the longest and shortest pile in each pier and abutment on the Structure location sheet. Also show changes in Bridge decks thickness;
12. All build notes shall be edited identifying changes made. Build notes not requiring edit shall be check marked;
13. Verify all Change Order information, excluding Gross Receipt Tax Change Orders, has been transferred to the Post Construction Plans and the proper sheets have been inserted and indexed and refer to the Change Order number;
14. Post Construction Plans should not use destructive binding & should be bound in a manner Acceptable by the Project Manager; and
15. General Notes/Call Out sheets shall be edited changing the tense of each item to indicate what was done; strike-through of items not required or completed on the Project shall be done retaining legibility.

802.4 METHOD OF MEASUREMENT

Post Construction Plans will be measured as a Lump sum unit.

802.5 BASIS OF PAYMENT

Post Construction Plans will be paid for the actual cost incurred, not to exceed the fixed amount entered by the Department into the Bid Schedule.

The Contractor shall provide the Project Manager with a detailed cost breakdown, including receipts and invoices of actual costs incurred.

For the purpose of bidding, the Department will enter into the Bid Schedule a fixed amount for Post Construction Plans.

Pay Item	Pay Unit
<i>Post Construction Plans</i>	Lump Sum

SECTION 803: SCHEDULE

803.1 DESCRIPTION

The Contractor shall be required to develop and maintain the CPM schedule with most current version of Primavera, P6. The Work described in this section shall consist of the Contractor providing a computer system with the most current version of Primavera, P6, for the NMDOT's exclusive possession for the use of the Critical Path Method ("CPM") schedule review. The Contractor shall also provide training and instruction to a maximum of six (6) Department employees as directed by the Project Manager in the use of CPM hardware, software, and evaluation of the Contractor's schedule. This Work includes the complete set up of the hardware and software prior to Pre-Con, removal after final Acceptance, providing of an independent commercial instructor, training supplies for three (3) separate eight (8)-hour training sessions. The timeframe for set up of the hardware and software prior to the Pre-Con can be modified in writing as needed by the Project Manager. All maintenance, repairs, and supplies required are the responsibility of the Contractor.

803.2 MATERIALS

803.2.1 General

Five (5) Days prior to delivery of the computer system, the Contractor shall submit for Acceptance of the Project Manager a detailed list of computer hardware and software the Contractor will furnish. The Contractor shall submit a proposed training schedule for the three (3) separate eight (8)-hour sessions for the concurrence of the Project Manager, one (1) week prior to the first proposed class. This schedule may be modified with the concurrence with the Project Manager. These submittals will be identified as part of Item 15 of Section 108.2, "Notice to Proceed and Pre-Construction Conference."

803.2.2 Computer System Hardware

The minimum computer system to be furnished shall be complete with computer, keyboard, mouse, monitor, printer, plotter, and Internet access as Wi-Fi Hotspot. Computer may be a laptop with docking station or desktop. The printer and/or plotter shall be capable of producing 8 ½ x11, 11 x 17 and 24 x 36 color prints/plots. If the plotter is capable of printing all three (3) sizes mentioned above, the Project Manager may not require an additional printer. Internet access as Wi-Fi Hotspot may be waived at the discretion of the Project Manager.

803.2.2.1 Computer System Maintenance

The Contractor shall furnish the CPM hardware and software and be responsible to install, setup, maintain, and repair the computer system. The Contractor shall provide all printer and plotter supplies as necessary during the course of the Project. The Contractor shall setup the hardware and software at the location determined by the Project Manager.

803.2.3 Computer System Software

The Contractor shall provide one (1) license of Primavera in the version used by the Contractor to develop and maintain the CPM schedule for use by the Department for the duration of the Project. The Contractor shall also include original instruction manuals (in electronic format).

803.2.4 CPM Training Materials

The Contractor shall provide a maximum six (6) computers equipped with software

compatible with baseline schedule for the training sessions. The Contractor shall provide manuals (in electronic format), handouts, and other Materials as deemed necessary by the Project Manager for the completion of the training.

803.3 CONSTRUCTION REQUIREMENTS

803.3.1 General

The Approved computer system shall be installed with the baseline schedule ready for use. The Contractor shall make hardware and software repairs within 48 hours of notification by the Project Manager, or shall provide replacement Equipment until repairs have been completed.

803.3.2 Training

The Contractor shall provide three (3) separate eight (8)-hour training sessions by an independent commercial trainer for a maximum of six (6) NMDOT staff as directed by the Project Manager. At least one (1) of the eight (8) hour sessions of commercial training shall be provided prior to the Pre-Construction Conference unless otherwise directed by the Project Manager. The time, location, and training agenda shall be at the sole discretion of the Project Manager.

The independent commercial trainer shall be capable of providing training in the software used to develop the Contractor's CPM, reviewing the baseline schedule, analysis of the schedule logic and critical path, and time impact analysis.

803.4 METHOD OF MEASUREMENT

The Department will pay 50% of the Lump Sum items on the first estimate and the remaining 50% of the Lump Sum items on the final estimate.

803.5 BASIS OF PAYMENT

Pay Item	Pay Unit
<i>Schedule Software</i>	Lump Sum
<i>CPM Training</i>	Lump Sum
<i>CPM Hardware/Equipment</i>	Lump Sum

803.5.1 Work Included in Payment

The Department will consider the following Work as included in the payment for Schedule and no separate payment will be made:

1. Set-up and maintenance;
2. All hardware including wiring;
3. All software and software updates;
4. Independent commercial trainer and training including Equipment and location;
5. Paper for plotter;
6. Ink cartridges for plotter and printer; and
7. Internet Access as Wi-Fi Hotspot.

DIVISION 900 – QUALITY CRITERIA

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SECTION 901: QUALITY CONTROL/QUALITY ASSURANCE (QC/QA) - GENERAL PROVISIONS

DEFINITIONS

TTCP Direct Supervision. The required supervision of a TTCP trainee by a certified TTCP technician who is on a Project with the trainee and who is both signing off and is personally responsible for all of that trainee's sampling and testing procedures, results and reports.

Qualified Sampling and Testing Technician. A technician who has been certified under TTCP to independently perform inspections, sampling, and testing in specified Materials testing area(s) for either Quality Control or Assurance testing. The term "qualified" and "certified" have the same meaning.

TTCP Trainee. A technician who has attended the appropriate TTCP training class and has a certificate of completion, and is receiving required "on-the-job-training" under the direct supervision of a TTCP certified technician, as such is eligible to take a particular TTCP certification exam.

QLA Validation. A procedure using statistical methods to compare the Contractor's and the Department's test results, specifically, the *F-test* to compare variances and *T-test* to compare means.

901.1 INSPECTIONS AND TESTING OF MATERIALS

901.1.1 General

Materials are subject to inspection, sampling, and testing before Acceptance of the Work. References in the Contract to test methods or Specifications are to the latest versions as of the Bid Advertisement date, unless otherwise noted. Test methods may be subject to modification at the discretion of the State Materials Bureau. The Department's current *TTCP Manual* contains AASHTO and ASTM test method modifications. Testing frequency must be equal to or greater than in accordance with Section 906, "Minimum Testing Requirements."

901.1.2 Technician Certification

Certification is based on demonstration of abilities for test methods and procedures, and a written test. The TTCP Board of Directors, in conjunction with the State Materials Bureau and the State Construction Bureau, will establish term and expiration date of certification and requirements for renewal of certification.

SECTION 902: QUALITY CONTROL

902.1 DESCRIPTION

902.1.1 General

This Work consists of the Contractor performing Quality Control which includes sampling, testing, and inspection to monitor and adjust its processes.

902.2 Quality Control Plan

Where a Contractor Quality Control Plan is required in the specifications, the Contractor shall provide a Quality Control plan as specified in this section. At the Pre-Construction Conference, the Contractor shall be prepared to discuss Quality Control responsibilities for specific Contract Items. The Contractor shall submit the Quality Control plan to the Project Manager at least two (2) weeks before starting Work on requiring the Plan. The Contractor shall not begin Work on HMA, WMA, OGFC, Base Course and PCCP that requires a Quality Control Plan until the Plan is reviewed and approved by the Project Manager and the District Laboratory Supervisor. The Quality Control Plan shall itemize inspections, testing procedures, sampling and testing frequencies, and corrective action strategies that the Contractor will use to control the Work. The Contractor shall develop the Quality Control Plan in accordance with Section 902.2.1, "Contractor Process Quality Control Plan."

902.2.1 Contactor Quality Control Plan for HMA/WMA and Base Course

The Plan shall address pertinent specifications.

902.2.1.1 Contractor Organization

Contractor Organization:

1. The Plan shall address authority levels/duties by position and name of persons holding those positions.
2. The Plan shall include those who can be contacted by State personnel and have decision making authority with regard to Quality Control, Materials, sampling and testing.

902.2.1.2 Sampling, Testing and Lab Facilities

Sampling, Testing and Lab Facilities:

1. The Plan shall include copies of TTCP certification or Wallet Card of all personnel who will be performing Process Quality Control testing for the Contractor.
2. The Plan shall identify lab location.
3. The Plan shall identify person(s) responsible for identifying random sampling locations.
4. The Plan shall identify how and when lab Equipment will be calibrated.
5. The Plan shall identify person(s) responsible for contacting Project Manager when lab facilities are ready for inspection.
6. The Plan shall identify person(s) responsible for maintaining control charts and all records associated with Materials sampling, testing and calibration of lab Equipment.
7. The Plan shall identify person(s) responsible for dispute resolution.

902.2.1.3 HMA/WMA Mix Design

HMA/WMA Mix Design:

1. The Plan shall identify which Department approved testing lab is responsible for mix design(s).
2. The Plan shall identify amount of Material that will be crushed or stockpiled prior to mix design submittal.
3. The Plan shall identify asphalt supplier.
4. The Plan shall outline asphalt sampling program to include frequency, storage and person(s) responsible for obtaining samples.
5. The Plan shall outline asphalt storage tank inspection procedure prior to initial loading, it shall identify the person responsible for storage tank inspection.

902.2.1.4 Aggregate Production

Aggregate Production:

1. The Plan shall identify pit location(s), and type of Material.
2. The Plan shall identify which approved testing lab is responsible for determining aggregate index (HMA, WMA, Base Course, and OGFC).
3. The Plan shall identify anticipated production rate during crushing.
4. The Plan shall identify number of stockpiles anticipated to be utilized in HMA/WMA mix design.
5. The Plan shall identify crushing Equipment that will be used to produce aggregate for HMA, WMA, Base Course and OGFC.
6. The Plan shall identify smallest sieve used to remove natural fines.
7. The Plan shall describe how test data will be utilized to identify inconsistencies and changes in aggregate being produced.
8. The Plan shall describe corrections that will be made when test data indicates Material properties have changed.
9. The Plan shall identify testing/sampling methods and frequencies that will be performed during crushing.

902.2.1.5 Stockpile Management, Stockpiled Material, and Quality Components

Stockpile Management, Stockpiled Material, and Quality Components:

1. The Plan shall describe how stockpiles will be constructed. Describe as a minimum how each requirement in Section 423.2.2.3, "Stockpiling" or Section 424.2.2.3, "Stockpiling" will be achieved.
2. The Plan shall identify testing/sampling methods and frequencies that was performed on stockpiled Material (LL, PL, FF, SE, flat & elongated, fine aggregate angularity, wet prep, gradation) for HMA, WMA, Base Course and OGFC.
3. The Plan shall describe how test data will be utilized to identify out of specification Material and what corrective actions will be taken.

902.2.1.6 Recycled Asphalt Pavement

Recycled Asphalt Pavement:

1. The Plan shall define RAP source and how representative samples will be obtained of sufficient quantity for mix design development.

2. The Plan shall identify approved testing lab that will perform AASHTO T-96 LA Wear, FF, Flat & Elongated and any additional testing that will be performed.
3. The Plan shall identify percent of RAP that will be used in each mix design.
4. The Plan shall describe process that will be used to develop mix design when using less 15% RAP.
5. The Plan shall describe process that will be used to develop mix design when using greater than 15% but less than 25% RAP.
6. The Plan shall describe process that will be used to develop mix design when using 25% to 35% RAP.
7. The Plan shall identify stockpile management and how many stockpiles will be maintained (minimum of two (2)).
8. The Plan shall identify what fractionation each stockpile will be divided into.
9. The Plan shall describe where RAP will be introduced into mixing drum.

902.2.1.7 Production of HMA/WMA

Production of HMA/WMA:

1. The Plan shall describe Equipment that will be used to produce HMA/WMA.
2. The Plan shall identify plant production rate.
3. The Plan shall describe how lime/anhydrite will be introduced into the mix and protected from wind loss.
4. The Plan shall describe how and when moisture will be added to activate lime/anhydrite.
5. The Plan shall identify amount of moisture that will be added and how cold feed moisture will be measured.
6. The Plan shall describe how consistent mixing temperature will be maintained.
7. The Plan shall describe how samples will be taken on combined Material (cold feed), excluding RAP and before addition of lime/anhydrite based Material.
8. The Plan shall identify sampling and testing frequency on combined Material for determination of Material passing the No. 40 sieve to be non-plastic, the plus 3/8" Material to contain a maximum of 20% flat, elongated particles with a dimensional ratio of 3:1 or greater, determination of fine aggregate angularity, SE, FF.
9. The Plan shall describe how test data will be used to identify consistency and changes in HMA/WMA being produced.
10. The Plan shall describe what corrective action process will start when test results are out of specification; this will include what increased frequency of testing is until corrective measures have brought mix back into specification.
11. The Plan shall describe method of loading and Equipment used to transport HMA/WMA.
12. The Plan shall describe length of haul and how adequate Material temperatures will be maintained.
13. The Plan shall identify specific WMA technology (must be on approved products list) and how it will be introduced in the production of WMA.
14. The Plan shall describe process used to manage WMA temperatures.

902.2.1.8 Placement of HMA/WMA

Placement of HMA/WMA:

1. The Plan shall identify how Material will be transferred from haul vehicles to placement Equipment.
2. The Plan shall describe how segregation will be prevented during placement.
3. The Plan shall describe paver speed, roller speed, number of rollers, number of trucks and plant production that will maintain a continuation of placement operations without stopping and starting.
4. The Plan shall describe proper use of auger extensions, if required and how proper amount of head in front of augers will be maintained.
5. The Plan shall describe pull widths and placement sequence that will achieve quantities/dimensions as shown on the plans.
6. The Plan shall describe how joints will be constructed and compaction of taper joints will be obtained.
7. The Plan shall describe how hand Work such as raking will be conducted on joints and how broadcasting aggregate onto mat will be prevented.
8. The Plan shall describe how acceptable compaction will be achieved including roller pattern and compaction monitoring process.
9. The Plan shall identify person(s) who will be tracking yield and person authorized to make adjustment to prevent overruns.
10. The Plan shall identify Department approved release agent that will be used to prevent mix from adhering to truck beds and other Equipment.
11. The Plan shall describe random sampling plan that will be utilized.
12. The Plan shall identify lot and sub lot sizes.
13. The Plan shall define how and where test strip will be constructed and evaluated for compliance with mix design.
14. The Plan shall define shakedown period and how it will be evaluated for compliance with mix design.
15. The Plan shall describe Process Quality Control sampling and testing frequency for each test that will be performed on the placed HMA/WMA.
16. The Plan shall identify time periods when WMA mixture can be sampled and testing can be performed.
17. The Plan shall describe how test data will be used to identify consistency and changes in HMA/WMA being placed.
18. The Plan shall describe what information will be utilized to make JMF changes.
19. The Plan shall describe what corrective action process will start when test results are out of specification; this will include what increased frequency of testing is until corrective measures have brought mix back into specification.

902.2.1.9 Base Course Placement

Base Course Placement:

1. The Plan shall identify any mixing and processing that will take place before Base Course (BC) is transported to the Roadway.
2. The Plan shall describe how BC will be transported to the Roadway.
3. The Plan shall describe how BC will be placed and spread.
4. The Plan shall describe how compaction will be monitored and achieve.
5. The Plan shall describe how line and grade control will be achieved.
6. The Plan shall identify lot and sub lot sizes.

7. The Plan shall identify person(s) who will be tracking yield and person authorized to make adjustment to prevent overruns.
8. The Plan shall describe random sampling plan that will be utilized.
9. The Plan shall describe Process Quality Control sampling and testing frequency for each test that will be performed on the placed BC (FF, gradation, LL, PI, moisture content, thickness, and density).
10. The Plan shall describe what corrective action process will start when test results are out of specification; this will include what increased frequency of testing is until corrective measures have brought BC back into specification.

902.2.1.10 OGFC Placement

OGFC Placement:

1. The Plan shall identify that the Contractor shall develop the mix design at no additional cost to the Department.
2. The Plan shall identify any anticipated differences in plan quantity tonnage due to Material types.
3. The Plan shall describe how plan depth will be maintained.
4. The Plan shall describe how design target AC content will be maintained.
5. The Plan shall define how low and defective areas will be corrected with hot OGFC before compaction.
6. The Plan shall define how finished surface will be smooth and free of irregularities larger than 1/8".

902.2.1.11 Smoothness

Smoothness:

1. The Plan shall identify if smoothness specification applies to this Project.
2. The Plan shall identify Department approved profiler that will be utilized.
3. The Plan shall identify Roadway surface preparation prior to profiling.
4. The Plan shall describe sequence measurements will be taken with accompanying NMDOT representative and submission of data.
5. The Plan shall describe evaluation of profile data using ProVAL for must grind Work and corrective Work required.
6. The Plan shall describe format of written corrective Work plan that will be submitted to the Project Manager.

Changes and data not available at time of submittal of the Plan can be added, although need to be approved by the Project Manager and District Lab Supervisor.

902.2.2 Contactor Quality Control Plan for PCCP

The plan shall address pertinent specifications.

902.2.2.1 Contractor Organization

Contractor Organization:

1. The Plan shall address authority levels/duties by position and name of persons holding those positions.

2. The Plan shall include those who can be contacted by State personnel and have decision making authority with regard to Quality Control, Materials, sampling and testing.
3. The Plan shall identify when Joint Layout Plan will be submitted in accordance with Section 450.3.4, "Joints."

902.2.2.2 Sampling, Testing and Lab Facilities

Sampling, Testing and Lab Facilities:

1. The Plan shall include copies of TTCP certification of all personnel who will be performing Process Quality Control testing for the Contractor.
2. The Plan shall identify lab location.
3. The Plan shall identify person(s) responsible for determining random sampling locations, and how the original random sampling locations will be confirmed.
4. The Plan shall identify how and when lab Equipment will be calibrated.
5. The Plan shall identify person(s) responsible for contacting the Project Manager when lab facilities are ready for inspection in accordance with Section 901, "Quality Control/Quality Assurance (QC/QA) - General Provisions."
6. The Plan shall identify person(s) responsible for maintaining control charts and all records associated with Materials sampling, testing and calibration of lab Equipment.
7. The Plan shall identify person(s) responsible for dispute resolution.

902.2.2.3 Concrete Mix Design

Concrete Mix Design:

1. The Plan shall identify concrete supplier.
2. The Plan shall provide copies of all approved mix designs and field report forms to be used;
 - a. If approved mix design is not available, the Plan shall identify how and when the approved mix will become available.

902.2.2.4 Aggregate Production

Aggregate Production:

1. If concrete mix design is approved using Standard Stockpile procedures, the Plan shall identify how stockpiles will be maintained and monitored to comply with;
 - a. Required master-band gradations; and
 - b. Fineness-modulus requirements.
2. If concrete mix design is approved using the Combined Gradation procedures, the Plan shall identify;
 - a. How the required gradations will be performed;
 - b. Who will perform the required gradations;
 - c. Where the required gradations will be performed;
 - d. How often the required gradations will be performed; and
 - e. How the information will be provided to the Department.
3. The Plan shall describe aggregate production and compliance. Includes control charts tracking items as indicated in Section 906, "Minimum Testing Requirements" and Section 902.8, "Control Charts."

4. The Plan shall describe stockpile management.

902.2.2.5 Batching & Hauling

Batching & Hauling:

1. The Plan shall identify manufacturer and type of Equipment.
2. The Plan shall define all batching procedures, including order of addition of individual ingredients.
3. The Plan shall identify how cement and fly ash will be:
 - a. Stored;
 - b. Kept separate;
 - c. Kept dry; and
 - d. Maximum anticipated time on-site before use.
4. The Plan shall identify how chemical admixtures will be stored and protected; and introduced into the mix.
5. The Plan shall identify the process used to manage concrete temperatures.
6. The Plan shall identify how aggregate moistures will be determined, monitored and communicated to the Department.
7. The Plan shall describe wash-down and final mixing procedures; after concrete mix has been loaded into trucks. Include process control performed, if any, at this point.
8. The Plan shall identify pre-departure procedures for all delivery trucks.
9. The Plan shall provide written approval of Batch Plant and all operations by NMDOT; to include scale certification.
10. The Plan shall identify proposed delivery rate.
11. The Plan shall identify Certificate of Inspection and Certification of all mixer trucks to be used on the Project.
12. The Plan shall identify proposed delivery route (haul road).
13. The Plan shall describe how Material temperatures will be maintained.
14. The Plan shall describe the corrective action process if batch weights are out of specification. This will include how the problem will be recognized, and at what point production will cease and a written corrective action Plan will be presented and approved by the Project Manager before resuming production.

902.2.2.6 Placement and Finishing of Concrete

Placement and Finishing of Concrete:

1. The Plan shall address verification process that subgrade/base has been approved and grades have been verified prior to concrete placement.
2. The Plan shall identify and describe placement method (slip form or construction by form).
3. The Plan shall describe placement and securing of dowels and tie bars.
4. The Plan shall describe Equipment and tools to be utilized.
5. The Plan shall identify how Material will be transferred from haul vehicles to placement location.
6. The Plan shall describe how Material handling Equipment will prevent segregation.
 - a. Include discussion on how segregation will be recognized, and how it will be eliminated, if detected; and

- b. Indicate how much Material will be maintained and monitored in front of the paver to prevent paste segregation.
7. The Plan shall describe method(s) for vibrating and consolidating concrete.
8. The Plan shall provide balance sheets that demonstrate how paver speed, number of trucks and plant production will maintain a continuation of placement operations without stopping and starting.
9. The Plan shall describe pull widths and placement sequence that will achieve quantities/dimensions as shown on the Plans.
10. The Plan shall describe method used to measure and maintain plan thickness.
11. The Plan shall describe joint Construction, longitudinal and transverse.
12. The Plan shall describe sawing operations.
 - a. What kind of sawing Equipment will be used;
 - b. How many units will be used;
 - c. How sawing operations will insure initial saw-cuts are made within the allotted time; and
 - d. How many and what kind of spare Equipment and parts will be maintained on-site.
13. The Plan shall describe joint sealing operations and Materials.
14. The Plan shall describe grooving or tining operations.
15. The Plan shall describe method(s) for curing concrete.
16. The Plan shall describe how evaporation potential will be monitored and provided to the Project Manager.
17. The Plan shall describe random sampling plan that will be utilized and documented.
18. The Plan shall identify lot and sub lot sizes.
19. The Plan shall define Shakedown Period and how it will be evaluated for compliance with mix design.
20. The Plan shall describe Process Quality Control sampling and testing used for compliance and control charts for tracking items in Section 906, "Minimum Testing Requirements" and Section 902.8, "Control Charts."
21. The Plan shall describe what corrective action process will be taken, and when it will be started when test results are out of specification; this will include what increased frequency of testing is until corrective measures have brought mix back into compliance. This will include a measure of threshold at which time concrete placement will cease and a written corrective action Plan will be presented and approved by the Project Manager before resuming placement.
22. The Plan shall describe method and Material available for constructing a bulk-head if it becomes necessary. This should just be that the concrete is cut back to the nearest joint that the surface plane meets the ten (10) ft straightedge tolerance.
23. The Plan shall describe what emergency covering and protective measures will be available in case of unforeseen weather or other events forcing unanticipated protection of the concrete.

902.2.2.7 Smoothness

Smoothness:

1. The Plan shall identify measures to be taken to insure smoothness.
2. The Plan shall identify if profiler smoothness specification applies to this Project.

3. The Plan shall identify Department approved profiler that will be utilized.
4. The Plan shall identify Roadway surface preparation prior to profiling.
5. The Plan shall describe sequence measurements will be taken with accompanying NMDOT representative and submission of data.
6. The Plan shall describe evaluation of profile data using ProVAL for must grind Work and corrective Work required.
 - a. The Plan shall insure proper version of ProVAL is available before Project begins. As with HMA we should be considering the filter to be used also.
7. The Plan shall describe format of written corrective Work Plan that will be submitted to the Project Manager.

Changes and data not available at time of submittal of the Plan can be added, although need to be approved by the Project Manager and District Lab Supervisor.

902.3 Quality Control Laboratory

The Contractor shall perform the Quality Control testing using a private testing Laboratory or a Contractor provided Laboratory. The Contractor shall use, at minimum, a portable or permanent Quality Control Type II Laboratory in accordance with Section 622.3.2.2, "Field Office Equipment." The Contractor shall calibrate or check testing Equipment in accordance with AASHTO R-18. The Contractor shall provide written documentation that testing Equipment is calibrated and meets the applicable Specifications.

The Contractor shall allow the Department unrestricted access to the Laboratory. The Department may conduct an independent inspection of the Contractor's field Laboratory. The Project Manager in conjunction with the District Lab Supervisor may determine acceptability of the Quality Control Laboratory. The Project Manager will provide the Contractor a written accounting of Laboratory deficiencies, if any.

902.4 Plan Administration and Technician Qualification

The Contractor shall identify the individual who will administer the Plan. The individual shall have full authority to take actions necessary for the successful operation of the Plan. Quality Control Technicians (QCT's) performing the actual sampling, testing, or inspection shall be TTCP certified as described in Section 901.1.2, "Technician Certification." The Contractor shall cease production if certified personnel are unavailable on the Project.

902.5 Sampling

The sampling plan shall contain a random sampling selection technique in accordance with specified Department, AASHTO, or ASTM procedures, as modified by the State Materials Bureau. The sampling plan shall be submitted as a component of the Quality Control Plan. The Contractor shall allow the Project Manager to witness all sampling and testing. The Contractor shall take additional samples if directed by the Project Manager.

902.6 Testing

The Department will use only test results from the random sampling plan in the quality level analysis for pay factor determination. Additional informational test results will not be used in the quality level analysis. The Contractor shall provide original Quality Control test results (on approved forms and to include all calculations, scratch sheets, internal forms etc.) to the Project Manager within two (2) Working Days of sampling. Failure to provide the test

results of sampling may result in the Project Manager ordering the Contractor to cease associated operations until said results are provided to the Project Manager.

902.7 Records

The Contractor shall maintain copies of the complete set of original Quality Control test records including supporting documents (calculations, scratch sheets, internal forms etc.), upon request, make them available to the Project Manager within 24 hours. The Technician performing the testing shall sign and certify the results as “true and accurate to the best of my belief and knowledge” prior to providing the results to the Department. No hard copy Laboratory testing documentation shall be destroyed for any reason, even after the data is entered into the computer spreadsheet for analysis. If complete records are not provided as requested, the Department may determine the pay factor using the Department’s test values only for all testing characteristics. The Contractor shall maintain copies of test documentation for a minimum of three (3) years after the Physical Completion Date of the Project.

902.8 Control Charts

The Contractor shall update test control charts daily on all tests in accordance with Section 906, “Minimum Testing Requirements.” The Contractor shall keep at a location approved by the Project Manager. The Contractor shall provide at least the following information on the charts:

1. Project number;
2. Contract Item number;
3. Test number;
4. Applicable test parameter; and
5. Upper and lower specification limit applicable to each test parameter.

902.9 METHOD OF MEASUREMENT—Reserved

902.10 BASIS OF PAYMENT

The Department will pay for *Contractor Process Quality Control* on Projects as follows:

1. 25% of the Lump sum pay item or 0.5% of the Total Original Contract Amount, whichever is less upon approval of the Quality Control Plan; and
2. The remaining Lump sum prorated based on total job progress.

The Department will withhold payment if the Contractor does not provide test result documentation in accordance with the Contract.

Pay Item	Pay Unit
<i>Contractor Process Quality Control</i>	Lump Sum

SECTION 903: QUALITY ASSURANCE

903.1 DESCRIPTION

The Department will sample and test Materials for Acceptance unless otherwise specified in the Contract. The Department will provide these test results to the Contractor within two (2) Working Days after sampling, but only after Contractor QC tests have been received for the same subplot, if applicable, and will provide other test results to the Contractor upon request. Department testing is not for Quality Control.

903.1.1 Department Sampling and Testing

The Department will sample and test in accordance with Section 906, "Minimum Testing Requirements" or at a lesser subplot size for Assurance purposes as determined by the Project Manager before production of Material begins. If Material appears defective, or if the Project Manager determines that a change in the process or product has occurred, additional sampling and testing may occur. When additional informational sampling and testing is performed, the results will be used only to determine if corrective actions need to be taken by the Contractor and will not be incorporated into the Quality Level Analysis.

The Department will conduct Assurance testing independently from the Contractor's Quality Control testing.

903.1.2 Independent Assurance Testing

TTCP certified independent personnel will perform Independent Assurance testing on split samples from Quality Control and Assurance programs to ensure that the Contractor and Department field personnel are using correct and accurate procedures and the proper Equipment. Independent Assurance Testing will be done in accordance with the most current NMDOT "Independent Assurance Program" and Section 906, "Minimum Testing Requirements." These personnel will not have direct responsibility for Quality Control or Assurance testing. Independent Assurance Test results will not be used for Acceptance.

903.1.3 Evaluation of Materials for QLA Acceptance

The Department will analyze lot test results collectively and statistically using Section 904, "Quality Level Analysis."

The Department may Accept a lot containing Material below a pay factor of one (1.00) at a reduced price, in accordance with the following criteria:

1. The composite pay factor is at least 0.75;
2. There are no rejectable individual criteria (Agency, Contractor or Combined); and
3. The Project Manager does not identify isolated defects (i.e., segregation, or other construction related Material defects).

The Department will consider a written request to Accept a Material lot below a 0.75 that does not meet the above criteria, but at a composite pay factor not to exceed 0.50. The Contractor shall include an engineering analysis showing expected Material performance. The Assistant District Engineer for Construction will decide if the Material may remain in place and determine the final pay factor for the Material in question. If less than three (3) samples are obtained at the time a lot is terminated, they shall be incorporated in the prior lot. If no prior lot exists, the disposition of the Material shall be decided by the Assistant District Engineer for Construction after evaluating with Minor Paving Non-QLA criteria in accordance with Section 416.3.1.2.1, "Acceptance."

The Project Manager may reject Material that appears to be defective based on visual inspection.

SECTION 904: QUALITY LEVEL ANALYSIS (QLA)

904.1 DESCRIPTION QUALITY LEVEL ANALYSIS (QLA)

The Department will analyze lot test results collectively and statistically using the Quality Level Analysis method. Quality Level Analysis is a statistical procedure for estimating the percent compliance with a specification; it is affected by shifts in the arithmetic mean, and by the sample standard deviations. The Department will use this analysis to estimate the total percent of the lot that is within specification limits. The maximum pay factor per lot is one (1.0).

If the Department's Assurance testing validates the Contractor's Quality Control testing, then the Department will use both sets for pay factor determination. Use of the Contractor's test results is dependent on the following conditions:

1. The Contractor uses Quality Control procedures as described in Section 902, "Quality Control."
2. The Department validates the Contractor's test results against the Department's test results using the *F-test* and *T-test*, conducted at a level of significance of 0.01.
3. The Contractor shall use all test results from the Contractor's random sampling plan as detailed in the Quality Control plan per Section 902, "Quality Control Plan." The Contractor shall not include informational test data obtained by test results beyond the Contractor's random sampling plan locations. If a split sample is taken to determine deviations between Contractor and Department process, only data obtained from a random sampling plan location can be utilized in the Quality Level Analysis. If a split sample is tested by the Contractor and Department for informational purposes and the location does not represent either the Contractor's or Department's random sampling plan locations, neither test data results are to be included in the Quality Level Analysis.

If the Department cannot validate the Contractor's test data at any time during the Project; the Project Manager and Quality Control technician will investigate to determine why and make corrections if possible. If the discrepancy cannot be resolved, then, unless otherwise approved by the Assistant District Engineer for Construction, the Department will determine the pay factor using the Department's test values only for characteristics that do not validate. Characteristics that do validate will use both Contractors and Departments data to determine pay factors.

The Contractor shall use the following steps to calculate the standard deviation:

1. Do not include test results for Material not used in the Work;
2. Calculate the arithmetic mean of the test results using the following equation:

$$\bar{x} = \frac{\sum x}{n} \quad \text{(Equation 1)}$$

Where,

- \bar{x} is the arithmetic mean
- \sum is the summation of
- x is the individual test value
- n is the number of test values

3. Calculate the sample standard deviations using the following equation:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{(n - 1)}} \quad \text{(Equation 2)}$$

Where,

s is the sample standard deviation

\sum is the summation of

x is the individual test value

\bar{x} is the arithmetic mean

n is the number of test values

4. Calculate the upper quality index using the following equation:

$$Q_U = \frac{USL - \bar{x}}{s} \quad \text{(Equation 3)}$$

Where,

Q_U is the upper quality index

USL is the upper specification limit, or TV plus allowable deviation above TV

\bar{x} is the arithmetic mean

s is the sample standard deviation

TV is the Target Value

5. Calculate the lower quality index using the following equation:

$$Q_L = \frac{\bar{x} - LSL}{s} \quad \text{(Equation 4)}$$

Where,

Q_L is the lower quality index

\bar{x} is the arithmetic mean

LSL is the lower specification limit or TV minus allowable deviation below TV

s is the sample standard deviation

6. Determine P_U (the percent of test values below the upper specification limit, which corresponds to a given Q_U) from Table 901.7:1, "Quality Level Analysis by the Standard Deviation Method Upper Quality Index Q_U or Lower Quality Index Q_L ." If a USL is not specified, P_U is 100.
7. Determine P_L (the percent of test values above the lower specification limit, which corresponds to a given Q_L) from Table 901.7:1, "Quality Level Analysis by the Standard Deviation Method Upper Quality Index Q_U or Lower Quality Index Q_L ." If an LSL is not specified, P_L is 100.
8. Calculate the quality level (the total percent within specification limits) using the following equation:

$$Q = (P_U + P_L) - 100 \quad \text{(Equation 5)}$$

Where,

- Q is the quality level
- P_U is the percent of test values below the upper specification limit which corresponds to a given upper quality index (Q_U)
- P_L is the percent of test values above the lower specification limit which corresponds to a given lower quality index (Q_L)
9. Using the quality level, determine the lot pay factor from Table 904.7:2, "Pay Factors."
10. Calculate the composite pay factor for each lot, using the following equation:

$$CPF = \frac{[f_1(PF_1) + f_2(PF_2)K + f_j(PF_j)]}{[f_1 + f_2K + f_j]} \quad (\text{Equation 6})$$

Where,

- CPF is the composite pay factor
- f is the price adjustment factor specified for the applicable Material pursuant to the tables below
- j is the number of evaluated components
- PF is the individual pay factor determined for each component

The Contractor shall carry the numbers in the above calculations to significant figures and round them in accordance with AASHTO R 11.

**Table 904.1:1
HMA/WMA Weighting Factors**

Characteristic	"f" Factor (%)
Mat Density	35
Air voids	35
Voids in the mineral aggregate (VMA)	20
Asphalt Content*	10

*If the individual pay factor for asphalt content is less than 0.75, it will be set at 0.75 for the purpose of calculating payment.

**Table 904.1:2
PCCP Weighting Factors**

Measured characteristic	Factor "f"
Entrained air	25
Compressive strength	25
Thickness	50

Table 904.1:3
QUALITY LEVEL ANALYSIS BY THE STANDARD DEVIATION METHOD
UPPER QUALITY INDEX QU OR LOWER QUALITY INDEX QL

Pu or Pl	n=														
	3	4	5	6	7	8	9	10 to 11	12 to 14	15 to 17	18 to 22	23 to 29	30 to 42	43 to 66	67 to ∞
100	1.16	1.49	1.72	1.88	1.99	2.07	2.13	2.20	2.28	2.34	2.39	2.44	2.48	2.51	2.56
99	—	1.46	1.64	1.75	1.82	1.88	1.91	1.96	2.01	2.04	2.07	2.09	2.12	2.14	2.16
98	1.15	1.43	1.58	1.66	1.72	1.75	1.78	1.81	1.84	1.87	1.89	1.91	1.93	1.94	1.95
97	—	1.40	1.52	1.59	1.63	1.66	1.68	1.71	1.73	1.75	1.76	1.78	1.79	1.80	1.81
96	—	1.37	1.47	1.52	1.56	1.58	1.60	1.62	1.64	1.65	1.66	1.67	1.68	1.69	1.70
95	1.14	1.34	1.42	1.47	1.49	1.51	1.52	1.54	1.55	1.56	1.57	1.58	1.59	1.59	1.60
94	—	1.31	1.38	1.41	1.43	1.45	1.46	1.47	1.48	1.49	1.50	1.50	1.51	1.51	1.52
93	1.13	1.28	1.33	1.36	1.38	1.39	1.40	1.41	1.41	1.42	1.43	1.43	1.44	1.44	1.44
92	1.12	1.25	1.29	1.31	1.33	1.33	1.34	1.35	1.35	1.36	1.36	1.37	1.37	1.37	1.38
91	1.11	1.22	1.25	1.27	1.28	1.28	1.29	1.29	1.30	1.30	1.30	1.31	1.31	1.31	1.31
90	1.10	1.19	1.21	1.23	1.23	1.24	1.24	1.24	1.25	1.25	1.25	1.25	1.25	1.26	1.26
89	1.09	1.16	1.18	1.18	1.19	1.19	1.19	1.19	1.20	1.20	1.20	1.20	1.20	1.20	1.20
88	1.07	1.13	1.14	1.14	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
87	1.06	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.11	1.11	1.11
86	1.04	1.07	1.07	1.07	1.07	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
85	1.03	1.04	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
84	1.01	1.01	1.00	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
83	0.99	0.98	0.97	0.96	0.95	0.95	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.94
82	0.97	0.95	0.93	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90
81	0.95	0.92	0.90	0.89	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
80	0.93	0.89	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.83
79	0.91	0.86	0.84	0.82	0.82	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.80	0.79
78	0.88	0.83	0.81	0.79	0.79	0.78	0.78	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76
77	0.86	0.80	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.73	0.73	0.73	0.73	0.73
76	0.83	0.77	0.74	0.73	0.72	0.72	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70
75	0.81	0.74	0.71	0.70	0.69	0.69	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.66
74	0.78	0.71	0.68	0.67	0.67	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.63
73	0.75	0.68	0.65	0.64	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.60

Table 904.1:3
QUALITY LEVEL ANALYSIS BY THE STANDARD DEVIATION METHOD
UPPER QUALITY INDEX QU OR LOWER QUALITY INDEX QL

Pu or Pl	n=														
	3	4	5	6	7	8	9	10 to 11	12 to 14	15 to 17	18 to 22	23 to 29	30 to 42	43 to 66	67 to ∞
72	0.73	0.65	0.62	0.61	0.60	0.59	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.57
71	0.70	0.62	0.59	0.58	0.57	0.57	0.56	0.56	0.55	0.55	0.55	0.55	0.55	0.55	0.54
70	0.67	0.59	0.56	0.55	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52
69	0.64	0.56	0.53	0.52	0.51	0.51	0.50	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49
68	0.61	0.53	0.50	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46
67	0.58	0.50	0.47	0.46	0.45	0.45	0.45	0.44	0.44	0.44	0.44	0.43	0.43	0.43	0.43
66	0.55	0.47	0.45	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.41	0.41	0.40
65	0.51	0.44	0.42	0.40	0.40	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.38	0.38	0.38
64	0.48	0.41	0.39	0.38	0.37	0.37	0.36	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.35
63	0.45	0.38	0.36	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.32
62	0.41	0.35	0.33	0.32	0.32	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30	0.30
61	0.38	0.30	0.30	0.30	0.29	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
60	0.34	0.28	0.28	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
59	0.31	0.27	0.25	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
58	0.30	0.25	0.23	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
57	0.25	0.20	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
56	0.20	0.18	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
55	0.18	0.15	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
54	0.15	0.13	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
53	0.10	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: For negative values of Qu or Ql, Pu or Pl is equal to 100 minus the table value for Pu or Pl. If the value of Qu or Ql does not correspond exactly to a figure in the table, use the next lower figure.

Table 904.1:4Pay Factors

Pay factor	Minimum Required Percent of Work Within Specifications Limits for a Given Pay Factor (Pu+PL) – 100														
	n=														
	3	4	5	6	7	8	9	10 to 11	12 to 14	15 to 17	18 to 22	23 to 29	30 to 42	43 to 66	67 to ∞
1.05	—	—	—	—	—	100	100	100	100	100	100	100	100	100	100
1.04	—	—	—	—	100	99	97	95	96	96	96	97	97	97	97
1.03	—	—	—	100	98	96	94	92	93	93	94	95	95	96	96
1.02	—	—	—	99	97	94	91	89	90	91	92	93	93	94	94
1.01	100	100	100	98	95	92	89	87	88	89	90	91	92	92	93
1.00	69	75	78	80	82	83	84	85	86	87	88	89	90	91	92
0.99	66	72	76	78	80	81	82	83	84	85	86	87	89	90	91
0.98	64	70	74	76	78	79	80	81	82	84	85	86	87	88	90
0.97	63	68	72	74	76	77	78	79	81	82	83	84	86	87	88
0.96	61	67	70	72	74	75	76	78	79	81	82	83	84	86	87
0.95	59	65	68	71	72	74	75	76	78	79	80	82	83	84	86
0.94	58	63	67	69	71	72	73	75	76	78	79	80	82	83	85
0.93	57	62	65	67	69	71	72	73	75	76	78	79	80	82	84
0.92	55	60	63	66	68	69	70	72	73	75	76	78	79	81	82
0.91	54	59	62	64	66	68	69	70	72	74	75	76	78	79	81
0.90	53	57	61	63	65	66	67	69	71	72	74	75	77	78	80
0.89	51	56	59	62	63	65	66	68	69	71	72	74	75	77	79
0.88	50	55	58	60	62	64	65	66	68	70	71	73	74	76	78
0.87	49	53	57	59	61	62	63	65	67	68	70	71	73	75	77
0.86	48	52	55	58	59	61	62	64	66	67	69	70	72	74	76
0.85	46	51	54	56	58	60	61	62	64	66	67	69	71	72	75
0.84	45	49	53	55	57	58	60	61	63	65	66	68	70	71	73
0.83	44	48	51	54	56	57	58	60	62	64	65	67	69	70	72
0.82	43	47	50	53	54	56	57	59	61	62	64	66	67	69	71
0.81	41	46	49	51	53	55	56	58	59	61	63	64	66	68	70
0.80	40	44	48	50	52	54	55	56	58	60	62	63	65	67	69
0.79	39	43	46	49	51	52	54	55	57	59	61	62	64	66	68
0.78	38	42	45	48	50	51	52	54	56	58	59	61	63	65	67
0.77	36	41	44	46	48	50	51	53	55	57	58	60	62	64	66

Table 904.1:4 Pay Factors

Minimum Required Percent of Work Within Specifications Limits for a Given Pay Factor (Pu+PL) – 100															
Pay factor	n=														
	3	4	5	6	7	8	9	10 to 11	12 to 14	15 to 17	18 to 22	23 to 29	30 to 42	43 to 66	67 to ∞
0.76	35	39	43	45	47	49	50	52	54	56	57	59	61	63	65
0.75	33	38	42	44	46	48	49	51	53	54	56	58	60	62	64
Reject	Values less than those shown above														

Note: If the value of (Pu+PL) – 100 does not correspond to a (Pu+PL) – 100 value in this table, use the next lower (Pu+PL) – 100 value

SECTION 905: QUALITY ASSURANCE FOR MINOR PAVING

905.1 DESCRIPTION

The Department will sample and test Materials for Acceptance unless otherwise specified in the Contract. The Department will provide these test results to the Contractor within two (2) Working Days after sampling. Any additional testing by the Department will be provided to the Contractor upon written request. Department testing is not for Quality Control.

905.1.1 Department Sampling and Testing for Acceptance

The Department will sample and test in accordance with Section 906, "Minimum Testing Requirements" or at a lesser subplot size for Assurance purposes as determined by the Project Manager before production of Material begins. If Material appears defective, or if the Project Manager determines that a change in the process or product has occurred, additional sampling and testing may occur. When the Department performs additional informational sampling and testing, the results will be used only to determine if corrective actions need to be taken by the Contractor.

905.1.2 Independent Assurance Testing

TTCP certified independent personnel will perform Independent Assurance testing on split samples from Quality Control and Assurance programs to ensure that the Contractor and Department field personnel are using correct and accurate procedures and the proper Equipment. These personnel will not have direct responsibility for Quality Control or Assurance testing. Independent Assurance Test results will not be used for Acceptance.

905.1.3 Evaluation of Materials for Acceptance

905.1.3.1 Acceptance

The Department will Accept the constructed product based on inspection and on Laboratory testing for conformance with the Contract. The Department will test samples of HMA/WMA taken from the Roadway before compaction and on cut pavement samples (cores). The Department will Accept the constructed product based on the following criteria:

1. Air voids as determined from Laboratory-compacted specimens in accordance with AASHTO T 166 and AASHTO T 209;
2. Asphalt content as determined by the tank strap method or plant asphalt metering system defined in the Contractor's Quality Control Plan (binder ignition oven calibration samples will not be required);
3. Final thickness of the compacted Material as measured from cores in accordance with ASTM D 3549; and
4. Density of the compacted Roadbed as determined in accordance with AASHTO T 310, Standard Method of Test for In-Place Density and Moisture Content of Soil-Aggregate by Nuclear Methods (Shallow Depth). The Contractor shall provide cores from three (3) locations designated by the Project Manager for correlation with the Nuclear Densometer.

Department representatives, certified in the relevant test procedures by the State Materials Bureau through TTCP, will perform Acceptance testing in accordance with AASHTO or Department methods, using the test methods and modifications in the current TTCP Manual.

905.1.3.2 Acceptance Lots and Pay Factor Determination

The Department will Accept density based on the average of all density tests per Project, taken at a minimum of ten (10) density tests per 5,000 tons, and will Accept air voids and asphalt content based on a minimum of three (3) tests per 5,000 tons.

The Department will determine pay factors in accordance with Table 905.1.3.2:1, “Price Adjustments for Density,” Table 905.1.3.2:2, “Price Adjustments for Air Voids,” Table 905.1.3.2:3, “Price Adjustments for Asphalt Content,” and Table 905.1.3.2:4, “Price Adjustment for Thickness.” The Department will obtain the TVs for asphalt content and air voids from the approved JMF and will determine payment for each Acceptance lot by multiplying the Bid Item Unit Price by the average of the pay factors per lot and multiplying the result by the total lot area.

**Table 905.1.3.2:1
Price Adjustments for Density**

Percent density	Pay factor (%)
> 97.99	Reject
97.0 – 97.99	90
96.0 – 96.99	95
92.50 – 95.99	100
91.50 – 92.49	95
90.50 – 91.49	90
90.0 – 90.49	80
< 90.00	Reject

**Table 905.1.3.2:2
Price Adjustment for Air Voids**

Percent deviation from TV	Pay factor (%)
< 1.3	100
1.31 – 1.69	90
1.7 – 1.99	75
≥ 2.0	Reject

**Table 905.1.3.2:3
Price Adjustment for Asphalt Content**

Percent deviation from TV	Pay factor (%)
< 0.29	100
0.36 – 0.55	90
≥0.56	Reject

**Table 905.1.3.2:4
Price Adjustment for Thickness**

Deficiency from plan minimum thickness	Pay factor (%)
None (Plan Minimum or Thicker)	100
<1/4 inch	100
1/4 inch–1/2 inch	90
1/2 inch–3/4 inch	75
3/4 inch–one (1) inch	50
>one (1) inch	Corrective action

The Contractor shall remove and replace rejected Material identified in Table 905.1.3.2:1, "Price Adjustment for Density," Table 905.1.3.2:2, "Price Adjustment for Air Voids," and Table 905.1.3.2:3, "Price Adjustments for Asphalt Content." Instead of removing and replacing rejected Material, the Project Manager may allow the Material to remain in place at 50% of the Bid Item Unit Price, if in the best interest of the Department.

The Contractor shall take corrective action if specified in Table 905.1.3.2:4, "Price Adjustment for Thickness." Corrective action includes removal and replacement of the unacceptable Material, overlay of the unacceptable Material, or other corrective actions approved by the Project Manager. Thin or feathered edge surface patching is not Acceptable. Overlay lift thicknesses must meet the requirement of Table 905.1.3.2:5, "HMA/WMA Lift Thickness."

**Table 905.1.3.2:5
HMA/WMA Lift Thickness**

HMA Type	Lift Thickness (Inches)	
	Minimum	Maximum
SP-III	2.5	3.5
SP-IV	1.5	3.0
SP-V	0.75	1.5

The Project Manager may reject Materials that appears to be defective based on visual inspection.

SECTION 906: MINIMUM TESTING REQUIREMENT'S (MTR'S)

906.1 DESCRIPTION

906.1.1 General

This Work consists of Minimum Testing Requirement's (MTR's) for the Department and Contractor which includes construction sampling, tests, and testing frequencies of Materials incorporated into the Work for Acceptance and Quality Control. Project Quantities less than the minimum Agency Testing requirement do not require IA Testing if Agency Testing is certified by the Assistant District Engineer – Construction.

906.1.2 Minimum Testing Requirements

**Table 906.1.2:1
Earthwork**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contract or Testing	Independent Assurance (a)		State Material s Bureau
					Project Approach	System Approac h	
Embankment, Unclassified Excavation (Section 203)	In-Place Density and Moisture	Roadway	1 per 2,000 cy	N/A	1 per 20,000 cy	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density/ Tests (Proctor), Soils Classification	Stockpile / Roadway	1 per material type per 15,000 cy		1 per 100,000 cy		
Borrow (Section 203.2.1.3)	AASHTO T-190 R-Value, Soils Classification	Borrow Pit	N/A	1 per 10,000 cy 1 per material type	N/A	1 every 3 months with each sampling/ testing technician	R-Value as needed. Testing perform ed by State Material s Bureau
Road Bed Embankment (Section 203.3.5.1)	In-Place Density and Moisture	Roadway	1 per 2,500 sq. yd.	N/A	1 per 25,000 sq. yd.	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density/ Tests (Proctor), Soils Classification		1 per material type		1 per project		
Foundations / Backfill for Culverts and Minor Structures	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per project	1 every 3 months with each sampling/ testing	N/A

**Table 906.1.2:1
Earthwork**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contract or Testing	Independent Assurance (a)		State Material s Bureau
					Project Approach	System Approach	
(Section 206)	Moisture/ Density/ Tests (Proctor), Soils Classification	Stockpile	1 per material type			technician	
	Electrochemical, where specified.		N/A		1/material type	N/A	
Subgrade Preparation (Section 207)	In-Place Density and Moisture	Roadway	1 per 2,000 sq. yd.	N/A	1 per 20,000 sq. yd.	1 every 3 months with each sampling/testing technician	N/A
	Moisture/ Density/ Tests (Proctor), Soils Classification		1 per material type		1 per project		
Blading and Re-shaping (Section 209)	In-Place Density and Moisture	Roadway	One per half mile	N/A	1 per 5 miles	1 every 3 months with each sampling/testing technician	N/A
	Moisture/ Density/ Tests (Proctor), Soils Classification		1 per material type		1 per project		
Backfill for Major Structures (Section 210)	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per 5,000 cy	1 every 3 months with each sampling/testing technician	N/A
	Gradation, PI	Stockpile	1 per 300 cy		1 per project		
	Moisture/ Density/ Tests (Proctor), Soils Classification		1 per material type				
Treated Sub grade (Section 306)	In-Place Density and Moisture	Roadway	1 per 3,000 sq yd	N/A	1 per 30,000 sq yd	1 every 3 months with each sampling/testing technician	N/A
	Moisture/ Density						

**Table 906.1.2:1
Earthwork**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contract or Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
	Tests (Proctor), Soils Classification		1 per material type		1 per project		
	AASHTO T-290 Sulfate Testing	Borrow Pit	N/A	1 per 10,000 cy	N/A		Upon Request
Backfill for Mechanical Stabilized Earth (MSE) Retaining Structures (Section 506)	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per 3,000 cy	1 every 3 months with each sampling/testing technician	N/A
	Moisture/Density Tests (Proctor)	Stockpile	1 per material type	1 per material type	1 per project		
	Gradation, LL, PI		1 per 300 cy		1 per 3,000 cy		
	Direct Shear, Electro Chemical		N/A		N/A	Upon Request	
Foundations for Slope and Erosion Protection Structures (Section 602)	In-Place Density and Moisture	Structure	1 per structure	N/A	1 per project	1 every 3 months with each sampling/testing technician	N/A
	Moisture / Density Tests (Proctor), Soils Classification	Foundation material location	1 per material type				
Backfill for Soil and Drainage Geotextiles (Section 604)	In-Place Density and Moisture	Roadway	1 per lift	N/A	1 per project	1 every 3 months with each sampling/testing technician	N/A
	Moisture/Density Tests (Proctor), Soils Classification	Stockpile	1 per material type				
Backfill for Drains (section 605.3.4)	In-Place Density and Moisture	Roadway	1 per 1,000 lf	N/A	1 per 10,000 lf	1 every 3 months with each sampling/testing	N/A

**Table 906.1.2:1
Earthwork**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contract or Testing	Independent Assurance (a)		State Material s Bureau
					Project Approach	System Approach	
	Moisture/ Density Tests (Proctor), Soils Classification	Stockpile	1 per material type	N/A	1 per project	technician	
Foundations for Sidewalks, Drive Pads and Concrete Median Paving (Section 608)	In-Place Density and Moisture	Roadway	1 per 150 sq. yd.	N/A	1 per 1,500 lf	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Foundation material location	1 per material type		1 per project		
Bed Course Material for Sidewalks, Drive Pads and Concrete Median Paving (Section 608)	In-Place Density and Moisture	Roadway	1 per 150 sq. yd.	N/A	1 per 1,500 lf	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Stockpile	1 per material type		1 per project		
Foundations for Curb and Gutter (Section 609)	In-Place Density and Moisture	Roadway	1 per 500 lf or as site locations require	N/A	1 per 5,000 lf	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Foundation material location	1 per material type		1 per project		
Bed Course Material for Curb and Gutter (Section 609)	In-Place Density and Moisture	Roadway	1 per 500 lf or as site locations require	N/A	1 per 5,000 lf	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Stockpile	1 per material type		1 per project		
Foundations / Backfill for Cattle Guards (Section	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per project	1 every 3 months with each sampling/ testing	N/A

**Table 906.1.2:1
Earthwork**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contract or Testing	Independent Assurance (a)		State Material Bureau
					Project Approach	System Approach	
610)	Moisture/ Density Tests (Proctor), Soils Classification	Stockpile	1 per material type			technician	
Bedding Material for Cattle Guards (Section 610)	In-Place Density and Moisture	Structure	1 per structure	N/A	1 per project	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Stockpile	1 per material type				
Foundations / Backfill for Drop Inlets and Junction Boxes (Section 623)	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per project	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Foundation material location	1 per material type				
Foundations / Backfill for Utilities (Section 660)	In-Place Density and Moisture	Structure	See Table 906.1.2:2	N/A	1 per project	1 every 3 months with each sampling/ testing technician	N/A
	Moisture/ Density Tests (Proctor), Soils Classification	Foundation material location	1 per material type				

Table 906.1.2:2

Structure Definitions, Foundation and Backfill Requirements for Acceptance

1. Transverse or skewed Culvert or concrete box Culvert (CBC), not connected to an underground drainage network, including end sections, wing walls if backfilled simultaneously, structural plate pipe, storm drains, and sewer lines (Note 1):

Foundation: One density per 100 linear feet. For pipe in a battery, up to 4 pipes may be considered as a unit for purposes of foundation density.

Backfill Density: One (1) per two (2) foot of fill per side* and to top of trench per 100 linear feet (Note 2).

*For a battery of pipes, the number of backfill densities required will be as follows:

One-Half (1/2) of the required densities for up to four (4) pipes.

Table 906.1.2:2

Structure Definitions, Foundation and Backfill Requirements for Acceptance

- One-Third (1/3) of the required densities for more than four (4) pipes.
2. End section or CBC wing wall if backfilled separately from culvert pipe or CBC (Note 2):
Backfill Density: One (1) per two (2) foot of fill per side.
 3. Drop inlet (D.I.), junction box, cattle guard, light and signal base, manhole, etc.:
Foundation: One (1) per structure.
Backfill Density: One (1) per two (2) foot of fill.
 4. Underground drainage network including interruptions such as D.I., manhole, junction box, plug, service connection, slotted drain, etc., if backfilled simultaneously:
Foundation: One (1) per 100 linear feet.
Backfill Density: One (1) per two (2) foot of fill per side and to top of trench per 100 linear feet (Note 2).
 5. Retaining wall / MSE wall:
Foundation: One (1) foundations density per 100 linear feet.
Backfill Density: One (1) per two (2) foot of fill per 100 linear feet.
 6. Bridge abutment back wall, wing wall or approach slab:
Backfill Density: One (1) per six (6) inches of fill.
 7. Pier footing:
Foundation: One (1) per footing.
Backfill Density: One (1) per six (6) inches of fill.
 8. Waterlines, electrical conduit, telephone cable or gas line, etc., within Roadway Prism (traveled area and Shoulder) if trench width is sufficient for density testing:
Foundation: One (1) per 100 linear feet.
Backfill Density: One (1) per two (2) foot of fill per 100 linear feet.
 9. Waterline, electrical conduit, telephone cable or gas line, etc. outside the Roadway Prism (traveled area and Shoulders) if trench width is sufficient for density testing:
Foundation: One (1) per 300 linear feet.
Backfill Density: One (1) per two (2) foot of fill per 300 linear foot.

Notes:

1. All extensions will be considered increments and as such structure units.
2. Determination of Backfill Depths Governing Minimum Testing Criteria Requirements:
 - a) When backfill construction is performed in trench conditions, the depth of compacted backfill to be tested shall be measured from the foundation to the top of the trench.
 - b) When backfill construction is performed in non-trench conditions, the depth of compacted backfill to be tested shall be determined through the use of the appropriate NMDOT Standard Drawings.

Table 906.1.2:3

Base Course

Item	Test Required	Sampling/ Testing	Agency Testing	Contractor Testing	Independent Assurance (a)	State Materials
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		Location			Project Approach	System Approach	Bureau
Base Course (Section 303)	In-Place Density and Moisture	Roadway after compaction	1 per 1,000 tons	N/A	1 per 20,000 tons with Agency	1 every 3 months with each sampling/testing technician	N/A
	Moisture/Density Tests (Proctor)	Stockpile	1 per material type		1 per project		
	Gradations	Processed material	1 per 2,000 tons		1 per 20,000 tons with Agency		
	FF, LL, PI		1 per 4,000 tons				
	Thickness	Roadway after compaction	1 per 1,000 tons		N/A		

*For Projects whose total is less than 1000 tons, IA testing is not required.

**Table 906.1.2:4
Aggregates**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Processing, Placing and Compacting Existing Pavement (Section 302)	In-Place Density	Roadway	1 per 1,000 sq yd	N/A	1 per 50,000 sq yd	1 every 3 months with each sampling/testing technician	N/A
	Gradation (Dry field sieve verification per TTCP)		1 per 5,000 sq yd				
Rip Rap Material (Section 602)	LA Wear & Soundness (AASHTO T-96 AASHTO T-104)	Source	N/A	1/year per pit	N/A	N/A	N/A

**Table 906.1.2:5
Minor Paving - Hot Mix Asphalt (HMA)/Warm Mix Asphalt (WMA)**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
HMA/WMA Minor Paving (Section 416)	Asphalt Content (Strap Method or Meter)	Asphalt Plant	N/A	1 per day	N/A	1 every 3 months with each sampling/testing technician	N/A
	Air Voids	Roadway	3 per lot	N/A	1 per project		
	Roadway Compaction Nuclear Densometer		10 per lot	Contractor to provide three (3) cores for Correlation of Densometer	1 per lot		
	Thickness		3 per lot	Obtain Cores	N/A		
Open Graded Friction Course (Section 403)	Gradation, FF	Cold Feed	1 per 3,000 tons with a minimum of 1 per day	1 per 250 tons 1st 2,000 tons then 1 per 500 tons after 2,000 tons	1 per 15,000 tons with Agency	1 every 3 months with each sampling/testing technician	N/A
		Crushing	N/A	1 per 1,000 tons	N/A		
	Performance Graded Asphalt Binder	From storage tank or Delivery Truck	1 sample consisting of three separate 1-quart increments per Project	Samples will be obtained by contractor personnel and observed by Department personnel	N/A	N/A	Material will be accepted in accordance with contract documents. A min. of one sample per project will be tested.

**Table 906.1.2:6
Asphalt Recycling**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Hot In-Place Recycling (Remixing Method) (Section 412)	Roadway Density (Nuclear Densometer)	Roadway	1 per 3,000 sq yd	N/A	1 per 30,000 sq yd	1 every 3 months with each sampling/testing technician	N/A
Single-Machine Hot In-Place Surface Repaving (Section 413)	Roadway Density (Nuclear Densometer)	Roadway	1 per 3,000 sq yd	N/A	1 per 30,000 sq yd	1 every 3 months with each sampling/testing technician	N/A
	HMA/WMA	Windrow / Hopper	See Section 416 Minor Paving		N/A		
Pavement Surface Restoration (In-Situ) (Section 415)	Roadway Density	Roadway	1 per 3,000 sq yd	N/A	1 per 30,000 sq yd	1 every 3 months with each sampling/testing technician	N/A
	Bulk Specific Gravity		2 sets/day				
Performance Graded Asphalt Binder (Section 402)	As required in the Contract Documents	From storage tank or delivery truck	Minimum 2 samples consisting of three separate 1 quart increments per Project. One from the Test Strip and one randomly selected from the project	Samples will be obtained by contractor personnel and observed by Department personnel. One sample will be obtained from the Test Strip, and one sample will be obtained for each 5000 tons asphalt mix	Random samples will be selected by District Laboratory Personnel and submitted to the SMB.	1 every 3 months with each sampling/testing technician	Material will be accepted in accordance with the Contract Requirements. A minimum of two samples per project will be tested.

**Table 906.1.2:7
Asphalt Mineral Admixture Materials**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Asphalt Emulsion (Section 402)	Manufacturer's certificate of compliance will suffice for testing credits	N/A	N/A	N/A	N/A	N/A	Material shall be provided by approved suppliers, in accordance with SMB procedures for Certification of Asphalt Suppliers.
Mineral Admixtures (Section 402)	Manufacturer's certificate of compliance will suffice for testing credits	N/A	N/A	N/A	N/A	N/A	N/A

**Table 906.1.2:8
Major Paving (Sections 423/424/900's) - Hot Mix Asphalt (HMA), Warm Mix Asphalt (WMA)**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance		State Materials Bureau
					Project Approach	System Approach	
HMA/WMA Superpave (Section 423/424)	Asphalt Content, Gradation, Gmm, Gmb, Air Voids, VMA, VFA, DP	Roadway	1 per 3000 tons. Gmm will be determined at least once per day.	1 per 1000 tons. Gmm will be determined at least twice per day.	1 per 15,000 tons	1 every 3 months with each samplin g/ testing technicia n	Referee Testing
	Roadway Compactio n (Cores)						
	Roadway Compactio n (nuclear/no n- destructive)						
	FF, SE, F&E, FAA, Moisture	Cold Feed before addition of Mineral Admixtures	N/A	As needed	N/A		

**Table 906.1.2:8
Major Paving (Sections 423/424/900's) - Hot Mix Asphalt (HMA), Warm Mix Asphalt (WMA)**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance		State Materials Bureau
					Project Approach	System Approach	
Performance Graded Asphalt Binder (Section 402)	As required in the Contract Documents	From storage tank or delivery truck	Minimum 2 samples consisting of three separate 1 quart increments per sample per Project. One from the Test Strip and one randomly selected from the project	Samples will be obtained by contractor personnel and observed by Department personnel. One sample will be obtained from the Test Strip, and one sample will be obtained for each 5000 tons asphalt mix	Random samples will be selected by District Laboratory Personnel and submitted to the SMB.	Random samples will be selected by District Laboratory Personnel and submitted to the SMB	Material will be accepted in accordance with contract requirements A minimum of two samples per project will be tested.
Asphalt Emulsion (Section 402)	Manufactures certificate of compliance will suffice for testing credits	N/A	N/A	N/A	N/A	Random samples will be selected by District Laboratory Personnel and submitted to the SMB	N/A

**Table 906.1.2:8
Major Paving (Sections 423/424/900's) - Hot Mix Asphalt (HMA), Warm Mix Asphalt (WMA)**

ITEM	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance		State Materials Bureau
					Project Approach	System Approach	
Mineral Admixtures (Section 402)	Manufactures certificate of compliance will suffice for testing credits	N/A	N/A	N/A	N/A	Random samples will be selected by District Laboratory Personnel and submitted to the SMB	N/A

**Table 906.1.2:9
Non-QLA Portland Cement Concrete**

Minor Structures, Curb & Gutter, Side Walks, etc. (509, 510, 511, 521)							
Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Fine Aggregates	Gradation	Stockpile	1 per 2 weeks during concrete production	1 per week during concrete production	1 per 10,000 cy, not required if less than 2,000 cy.	1 every 3 months with each sampling/testing technician	N/A
Course Aggregates							

**Table 906.1.2:9
Non-QLA Portland Cement Concrete**

Minor Structures, Curb & Gutter, Side Walks, etc. (509, 510, 511, 521)							
Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Non-Shrink Grout Aggregate	Manufacture certificate of compliance will suffice for testing credits	N/A	N/A	NA	N/A	N/A	N/A
Project Acceptance Test	Compressive Strength Cylinders, and Plastic Properties	See Table 906.1.2:14	Each mix design per day of placement. Test the first three loads, with one randomly sampled for one set of cylinders. Sample for testing and cylinders, one random load from each subsequent 6 load subplot	N/A	1 per project	1 every 3 months with each sampling/ testing technician	N/A

**Table 906.1.2:10
Non-QLA Portland Cement Concrete**

Major Structures, Substructures, Drilled Shafts (502, 509, 510, 511, 521)							
Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	

**Table 906.1.2:10
Non-QLA Portland Cement Concrete**

Major Structures, Substructures, Drilled Shafts (502, 509, 510, 511, 521)							
Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Fine Aggregates	Gradation	Stockpile	1 per 2 weeks during concrete production	1 per week during concrete production	1 per 5,000 cy, not required if less than 500 cy.	1 every 3 months with each samplin g/ testing technici an	N/A
Course Aggregates			N/A				
	FF, F&E						
Non-Shrink Grout Aggregate	Manufactur e certificate of compliance will suffice for testing credits	N/A	N/A	NA	N/A	N/A	N/A

**Table 906.1.2:10
Non-QLA Portland Cement Concrete**

Major Structures, Substructures, Drilled Shafts (502, 509, 510, 511, 521)							
Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Project Acceptance Test	Compressive Strength Cylinders, and Plastic Properties	See Table 906.1.2:14	Each mix design per day of placement. Test the first three loads, with one randomly sampled for one set of cylinders. Sample for testing and cylinders, one random load from each subsequent 6 load subplot	Each mix design per day of placement. Test the first three loads and one load from each 6 load subplot for plastic properties	1 per project	1 every 3 months with each sampling/ testing technician	N/A

**Table 906.1.2:11
Non-QLA Portland Cement Concrete Pavement (Section 509 and 451)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Fine Aggregates	Gradation	Stockpile	1 per 2 weeks during concrete production	1 per week during concrete production	1 per 5,000 cy, not required if less than 500 cy	1 every 3 months with each sampling/ testing technician	N/A

**Table 906.1.2:11
Non-QLA Portland Cement Concrete Pavement (Section 509 and 451)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Coarse Aggregates							
	F.F, F&E		N/A	Minimum 1 per project per coarse aggregate type	N/A		
Project Acceptance Test	Compressive Strength Cylinders, and Plastic Properties	See Table 906.1.2:14	Per day of placement. Test the first three loads, with one randomly sampled for one set of cylinders. Sample one random load from each subsequent 6 load subplot	Per day of placement. Test the first three loads and one load from each subsequent 6 load subplot for plastic properties	1 per 10,000 sy	1 every 3 months with each sampling/ testing technician	N/A
	Thickness	Roadway	1 per 300 cy	N/A	N/A		
Environmental Conditions	Evaporation Rate	Placement Site	N/A	Evaporation Potential determined at intervals not greater than 5 minutes until final curing system in place	N/A	N/A	N/A

**Table 906.1.2:12
Non-QLA Superstructure Concrete (Section 509, 510, and 512)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Fine Aggregates	Gradation	Stockpile	1 per 2 weeks during concrete production	1 per week during concrete production	1 per project.	1 every 3 months with each sampling/ testing technician	N/A
Coarse Aggregates							
Project Acceptance Test	Compressive Strength Cylinders, and Plastic Properties	See Table 906.1.2:14	For each mix design per day of placement. Test the first three loads, with one randomly sampled for one set of cylinders. Test and sample one random load from each subsequent 3 load sublot	Each mix design per day of placement. Test the first three loads and one load from each 3 load sublot for plastic properties	1 per 300 cy	1 every 3 months with each sampling/ testing technician	N/A

**Table 906.1.2:12
Non-QLA Superstructure Concrete (Section 509, 510, and 512)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance (a)		State Materials Bureau
					Project Approach	System Approach	
Environmental Conditions	Evaporation Rate	Placement Site	N/A	Evaporation Potential determined at intervals not greater than 5 minutes until final curing system in place	N/A	1 every 3 months with each sampling/ testing technician	N/A

**Table 906.1.2:13
QLA Portland Cement Concrete Pavement (Section 450)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance		State Materials Bureau
					Project Approach	System Approach	
Fine Aggregates	Gradation	Stockpile	1 per week during concrete production	1 per day per day of production	Minimum 2 per project	1 every 3 months with each project sampling/ testing technician	Referee Testing
Coarse Aggregates	Gradation, F.F., F&E						
Project Acceptance Test	Compressive Strength Cylinders, and Plastic Properties	See Table 906.1.2:14	1 per 500 cy	One set of cylinders from one of the first three trucks. 1 set per 125 cy thereafter	1 per 2,500 cy	1 every 3 months with each project sampling/ testing technician	Referee Testing

**Table 906.1.2:13
QLA Portland Cement Concrete Pavement (Section 450)**

Item	Test Required	Sampling/ Testing Location	Agency Testing	Contractor Testing	Independent Assurance		State Materials Bureau
					Project Approach	System Approach	
				For each of the first three trucks. 1 set per 125 cy from the trucks selected for compressive strength testing thereafter.			
	Thickness	Roadway	1 per 5,000 sq. yd.	1 per 2,500 sq. yd.	N/A		
Environmental Conditions	Evaporation Rate	Placement Site	N/A	Evaporation Potential determined at intervals not greater than 5 minutes until final curing system in place	N/A	N/A	N/A

Table 906.1.2:14

Method of Placement	Sample Location
Pumped	Point of discharge from pump into Structure
Direct Discharge from Truck	At end of discharge chute of truck
Crane and Bucket	From discharge chute of bucket
Conveyor belt	From Material on Roadway after being discharged from conveyor
Slip Form (Curb and Gutter/Barrier Walls)	Point of discharge into extrusion machine
Slip Form Paver (PCCP)	From grade in front of paving machine
Drill Shafts	At end of discharge chute of truck

**Table 906.1.2:15
Tolerances for Comparison of Independent Assurance Sample Tests
to Acceptance and Process Control Tests**

Characteristics	Tolerances
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Moisture/Density Test (Proctor)	± 3.0 PCF*, ± 2 Units for Moisture
In Place Moisture/Density (Roadway)	± 3.0 PCF, ± 2 Units for Moisture
Plasticity Index (P.I.)	± 3 Units

*Only if proctors are run by both District and Project. If proctors are not run by both District and Project ± 5.0 PCF.

Gradation	Tolerances
1 1/2" to 3/4"	± 6 Units
1/2" to No. 4	± 5 Units
No. 8 through No. 200	± 4 Units
Fractured Faces	± 5 Units
Flat & Elongated	± 5 Units
Fine Aggregate Angularity	± 3 Units
Sand Equivalent	± 4 Units
Aggregate Specific Gravity	± 0.020

Concrete	Tolerances
Slump	± 0.5 Inch
Unit Weight	± 2.0 PCF
Compressive Strength	10% or less = Range / Average x 100%

Hot Mix Asphalt (HMA)/Warm Mix Asphalt (WMA)	Tolerances
Roadway Density (Cores from Project, retained by Agency and Contractor Personnel)	± 0.025 Units
Density (Nuclear)	± 4 Units
VMA	± 1.0 Units
Asphalt Content (Ignition Burn Oven)	± 0.50
Bulk Specific Gravity at Ndes	± 0.025 Units
Maximum Specific Gravity	± 0.020 Units
Air Voids	± 1.5 Units

SECTION 910: AGGREGATE INDEX

910.1 Description

The Aggregate Index (AI) combines test values from the Los Angeles Wear Test, Soundness Loss Test, and Absorption Test. The AI is a single value representing the overall quality of the source from which the aggregates are obtained. The Contractor shall not use an individual aggregate stockpile for AI determination.

910.2 Sampling and Testing Procedures

The Contractor shall:

1. Determine Los Angeles wear, soundness loss, and absorption values for the AI equation using at least five (5) random test samples obtained from all stockpiles at the source in accordance with AASHTO T 2.
2. Submit all of the five (5) samples to a Department approved Private Testing Laboratory for combination into a single sample. The Project Manager or the State Materials Bureau will have a list of approved Private Testing Laboratories.
3. Extract a representative test sample from the single sample to determine the Los Angeles wear and absorption values.
4. Prepare the sample used to determine the absorption as follows:
 - a. Plus 3/4 inch 1000 grams
 - b. 3/4 inch to 1/2 inch 1000 grams
 - c. 1/2 inch to 3/8 inch 1000 grams
 - d. 3/8 inch to #4 1000 grams
5. Separate the remaining amount of the single sample into five (5) test samples using the procedures in AASHTO T 248.
6. Calculate a soundness loss value for each of these five (5) samples using Table 910.2:1, "Standard Gradation for Soundness Loss Testing."

**Table 910.2:1
Standard Gradation for Soundness Loss Testing**

Sieve size	% passing
1 1/4 inch	100
1 inch	100
3/4 inch	79
1/2 inch	53
3/8 inch	34
No. 4	0

7. Average the five (5) soundness loss results to obtain the overall soundness loss value for the subject aggregate pit.

910.2.3 Testing of Aggregates

The Contractor shall perform the following tests using a Department approved Private Testing Laboratory:

1. Los Angeles Wear (in accordance with AASHTO T 96, Method B);
2. Soundness loss (in accordance with AASHTO T 104); and

3. Absorption (in accordance with AASHTO T 85).

The Contractor shall:

1. Use the same Private Testing Laboratory for the entire Project unless otherwise approved (in writing) by the Project Manager.
2. Obtain samples under the observation of the Project Manager or Department designee.
3. Send copies of test reports to the Project Manager.

910.2.4 Frequency of Testing

The Contractor shall submit samples at least once every year to maintain continuous approval of Commercial Material Sources.

910.2.5 Equation

The Contractor shall calculate the AI of a coarse aggregate to the nearest whole number in accordance with the following equation:

$$AI = \frac{1}{3} \sqrt[3]{LA^{2.2} + SL^{3.0} + A^{4.0}} \quad (1)$$

Where,

AI is the aggregate index

LA is the Los Angeles Wear, the percent of aggregate wear at 500 revolutions if tested in accordance with AASHTO T 96

SL is the soundness loss of the sample if tested in accordance with AASHTO T 104 using magnesium sulfate with a test duration of five (5) cycles and the standard gradation in table 910.2:1

A is the absorption, the amount of moisture retained if tested in accordance with AASHTO T 85

Example:

1. Determine the L.A. Wear as a whole number – for example, 25;
2. Determine the Soundness Loss as a whole number – for example, 15;
3. Determine the Absorption as a whole number – for example, 3;
4. Calculate the value of the L.A. Wear taken to the 2.2 power – that is, $25^{(2.2)} = 1189.8$;
5. Calculate the value of the Soundness Loss taken to the 3rd power – that is, $15^{(3)} = 3375$;
6. Calculate the value of the Absorption taken to the 4th power – that is, $3^{(4)} = 81.0$;
7. Add the value obtained from steps 4, 5, and 6 – that is, $11.89.8 + 3375 + 81.0 = 4645.8$;
8. Determine the square root of Step 7 – that is, $\sqrt{(4658.8)} = 68.2$;
9. Divide the result from Step 8 by 3 – that is, $68.2 \div 3 = 22.7$; The A.I. for this sample is 22.7.