

Utah Department of Transportation



2017 Standard Specifications

For Road and Bridge Construction

January 1, 2017

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Introduction

These Standard Specifications are for use in Utah Department of Transportation construction contracts. The book incorporates all Supplemental Specifications approved for the 2012 Standard Specification Book and all approved changes in preparing the 2017 Edition.

The Standard Specifications are written to the Contractor. They define the Contractor's responsibility, what the Contractor is expected to provide, and the Department's expectations. All actions are to be performed by the Contractor unless otherwise noted.

Supplemental Specifications may revise the requirements in these Specifications. A Special Provision may revise the Standard for a specific contract.

References

Standard Specifications are available at:
<http://www.udot.utah.gov/go/2017standards>

Web references within these Standards are listed at
<http://www.udot.utah.gov/go/standardsreferences>.

Reference to external publications in any 2017 Standard is to the most recent version, issue, or edition in effect on the date of the *Notice to Bidders*, unless stated otherwise.

Layout

SECTION NUMBER TITLE

PART (1, 2, or 3)
ARTICLE (such as 1.1, 1.2, 2.1, 2.2, 3.1, 3.2)
Paragraph (such as A, B, C under an article)

Example:

PART 1 GENERAL
1.1 ARTICLE
 A. Paragraph
 1. Subparagraph
 a. Subparagraph
 1) Subparagraph
 a) Subparagraph

Page Numbering

The Standard Sections of this book each have separate numbering for each Section. There is no cumulative page numbering.

New Sections, Title Changes, Section Deletions

Note: This listing shows changes for the 2017 Standards as indicated for each item.

New Sections

Section 00100	General Provisions
Section 00700	Schedule and Narrative
Section 00747	Dispute Review Board
Section 00777	Change Management
Section 01450	Submittals
Section 01501	Mobilization
Section 01540	Public Information Services
Section 02701	Pavement Smoothness
Section 02744	Stone Matrix Asphalt (SMA)
Section 02894	Precast Roadside Sign Foundations
Section 03057	Structural Lightweight Concrete
Section 03251	Post Tensioning Concrete
Section 03341	Partial Depth Precast Concrete Deck Panels
Section 03374	Move Bridge
Section 03375	Bridge Deck Methacrylate Resin Treatment
Section 05121	Structural Plate Pipe
Section 05831	Compression Joint Seal

Title Changes

Section 01892	Reconstruct Catch Basin, Manhole, and Miscellaneous Boxes (Old Title – Reconstruct Catch Basin, Cleanout, Meter, Valve, Manhole, and Monument Boxes)
Section 02372	Gabions And Revet Mattresses (Old Title – Wire Enclosed RIPRAP)
Section 02376	Rolled Erosion Control Products (Old Title – Steep-Slope Erosion Control and Flexible Channel Liner)
Section 02613	Drainage Pipe End Sections (Old Title – Culvert End Sections)
Section 02622	Pipe Underdrain (Old Title – Underdrain)
Section 02624	Approach Slab Catch Basin Modification (Old Title – Approach Slab Catch Basin)
Section 02626	Deck Drain Modification (Old Title – Deck Drain Modification or Clousure)
Section 02635	Grates, Covers, Frames, Trash Racks, and Manhole Steps (Old Title – Grates, Solid Covers, Frames, and Manhole Steps)
Section 02705	Concrete And Asphalt Cutting (Old Title – Pavement Cutting)

Section 02771	Ada Pedestrian Access Ramps (Old Title – Curbs, Gutters, Driveways, Pedestrian Access Ramps, and Plowable End Sections)
Section 02776	Concrete Flatwork (Old Title – Concrete Sidewalk, Median Filler, and Flatwork)
Section 02911	Hydraulic Erosion Control Products (Old Title – Wood Fiber Mulch)
Section 03311	Bridge Deck Joint Closure (Old Title – Joint Closure)
Section 03339	Full-Depth Precast Concrete Deck Panel (Old Title – Precast Concrete Deck Panel)
Section 03924	Structural Concrete Repair (Old Title – Structural Concrete Repair and Sealing)
Section 13595	ATMS Integration, Testing, and Acceptance (Old Title – ATMS Integration)

Deleted Sections

Section 01284	Prompt Payment
Section 01285	Mobilization (Now Section 01501)
Section 01315	Public Information Services (Now Section 01540)
Section 02374	Grouted RIPRAP
Section 02614	Salvage and Re-Lay Pipe Culvert and End Sections
Section 02643	Concrete-Lined Ditch
Section 02712	Lean Concrete Base Course
Section 03393	Concrete Healer/Sealer
Section 07111	Damproofing
Section 07922	Relief Joint Crack Sealing
Section 13551	General ATMS Requirements
Section 13558	Highway Advisory Radio (HAR) Preparation
Section 13561	ATMS Power Service
Section 13593	Weigh in Motion

SECTION 00100

GENERAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provisions related to the interpretation of the contract.
 - 1. Includes document organization, language, and communication.

1.2 RELATED SECTIONS

- A. Section 00570: Definitions

1.3 REFERENCES

- A. UDOT Structures Design and Detailing Manual (SDDM)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 GENERAL

- A. The plans and specifications are expressed in US customary units except where a referenced document uses the International System of Units as the standard.

1.7 ORGANIZATION

- A. Specifications
 - 1. The specifications are organized by sections.
 - a. Each section defines a portion of the project requirements and is identified by a number and a title.

- b. References to specification sections use section numbers.
 - 1) Section references apply to the complete specification section consisting of the Standard Specification, Supplemental Specification, and Special Provision for the referenced section.
- 2. Sections up to and including Section 01499 are general specifications applicable to every contract unless specified as applicable under certain conditions.
 - a. General specifications include administrative requirements applicable to the contract and apply without reference.
 - b. General specifications apply to and govern the work of all Sections of the specifications
- 3. Sections beginning with Section 01500 through the end of the specifications are technical specifications for specific pay items.
 - a. The pay items in a contract designate the technical specifications that apply to a specific contract.
- 4. Section numbers of Special Provisions and Supplemental Specifications indicate the extent of the revision to the Standards.
 - a. A section number followed by "S" (for example, "01234S"), indicates a new section or a complete replacement of a Standard Specification section.
 - 1) This applies to Special Provisions only, not to Supplemental Specifications.
 - b. A section number followed by "M" (for example, "01234M"), indicates that part of a Standard is changed, added, or deleted.
 - 1) This applies to both Special Provisions and Supplemental Specifications.
- 5. Specification sections are written in a three-part format. Each Section contains the following primary PARTS:
 - a. PART 1 GENERAL
 - 1) Describes administrative and procedural requirements unique to the section.
 - b. PART 2 PRODUCTS
 - 1) Describes systems, assemblies, equipment, products, materials, fabrications, and mixes.
 - c. PART 3 EXECUTION
 - 1) Describes site installation or application, including preparatory actions and post-installation cleaning and protection.
 - 2) Includes site-built or site-manufactured assemblies.

6. Information describing the section format related to articles, paragraphs, and sub-paragraphs is shown in Figure 1.

Figure 1

Specification Layout	
SECTION NUMBER TITLE	
PART (1, 2, or 3)	
ARTICLE (such as 1.1, 1.2, 2.1, 2.2, 3.1, 3.2)	
Paragraph (such as A, B, C under an article)	
Example:	
PART 1	GENERAL
1.1	ARTICLE
A.	Paragraph
1.	Subparagraph
a.	Subparagraph
1)	Subparagraph
a)	Subparagraph

B. References

1. Reference to external publications is to the most recent version, issue, or edition in effect on the date of the *Notice to Bidders*, unless stated otherwise.
2. Reference to a specification section incorporates all applicable requirements of the referenced section.
 - a. Example: A reference in Part 2 of a section to Section 03055 for the product Class AA(AE) Concrete incorporates into the section all General, Products, and Execution requirements in Section 03055 applicable to Class AA(AE) Concrete.
 - b. Example: A reference in Part 3 of a section that refers to Section 03390 for concrete curing incorporates into the section all General, Products, and Execution requirements in Section 03390 applicable to curing the concrete elements.
 - c. Example: A reference in Part 3 of a section to Section 03310 for concrete placing and finishing incorporates into the section all General, Products, and Execution requirements in Section 03310 applicable to placing and finishing concrete.

3. References to articles and paragraphs within a section may omit the terms "Article," "Paragraph," and "Subparagraph."
 - a. Example: A reference to "this Section, 3.2 A4c" means Article 3.2, paragraph A, subparagraph 4c in the same section where the reference is made.
4. Applicable requirements in a referenced section or external publication apply the same as if they are included in their entirety in the section from which they are referenced.
 - a. The requirements of a section take precedence over referenced requirements in the case of conflict.
5. Interpret the words "shown," "specified," or "described" without a specified location as follows:
 - a. "Shown" means "shown in the plans."
 - b. "Specified" means "specified in the specifications."
 - c. "Described" means "described in the Contract."

C. Pay Items

1. Each pay item is identified by a unique number and name.
 - a. The pay item number and name identify the pay item throughout the Contract.
2. The first five digits of a pay item number are the section number of the technical specification that defines the work for that pay item.
3. The last character of a pay item signifies whether something is new or changed.
 - a. A digit as the last character indicates a standard pay item.
 - b. An asterisk (*) in place of the last digit indicates that the pay item is supported by a contract specific Special Provision.
 - c. The letter "P" in place of the last digit indicates that a new pay item that does not require a Special Provision is used or that the name, unit of measure, or Measurement & Payment (M&P) description of a standard pay item has been modified.
 - d. The letter "D" in place of the last digit indicates a standard lump sum pay item with an estimated quantity in the item name.

1.8 LANGUAGE

- A. The plans and specifications are written to the Contractor.
- B. The plans and specifications are written in the active voice where the subject is expressed or implied.
 1. Instructions written in the imperative mood are directed at the Contractor.
 - a. The subject, "the Contractor," is implied.
 - b. Imperative mood statements are considered mandatory.
 - 1) Example: "Place the concrete."

2. Decisions and actions by the Department or third parties are written in the indicative mood.
 - a. The subject, “the Engineer” or a third party, is expressed.
 - 1) Example: “The Engineer will take a sample.”
- C. The Contract Documents may omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement in the interest of brevity.
- D. Refer to Section 00570 for the meaning of abbreviations or terms used in these specifications, the plans, and other contract documents.
 1. Refer to the UDOT SDDM for the meaning of abbreviations used in the structure drawings.

1.9 COMMUNICATION

- A. Submit documents and direct questions in writing to the Engineer.
- B. Orders, approvals, authorizations, and requests to the Contractor are by the Engineer unless specifically described as by another.
- D. The following items from the Department are in writing:
 1. Approvals
 2. Authorizations
 3. Decisions
 4. Notifications
 5. Orders
 6. Responses
 7. Direction
- E. The following items from the Contractor must be in writing:
 1. Assignments
 2. Notifications
 3. Proposals
 4. Reports
 5. Requests
 - a. Includes Requests For Information (RFIs), sequentially numbered
 6. Subcontracts
 7. Test results
- F. Use the Department’s Information Technology (IT) systems for the documentation and communication processes contained therein.
 1. Documentation and communication are deemed to be in writing.

2. Approvals and electronic signatures may be required and are deemed to be executed and binding.

1.10 REQUESTS FOR INFORMATION (RFI)

- A. Request an interpretation of the requirements in the Contract Documents if:
 1. Unable to determine from the Contract Documents the exact material, process, or system to be installed
 2. Elements of construction are required to occupy the same space (interference)
 3. An item of Work is described differently at more than one place in the Contract Documents
- B. Submission of RFIs
 1. Prepare and submit RFIs on a form completely filled in and fully legible after photocopying or scanning
 2. Give each RFI a discrete, consecutive number.
 3. Provide on each page of the RFI and each attachment to the RFI the project name, project number, date, RFI number, and a descriptive title.
 4. Sign all RFIs attesting to a good faith effort to determine from the Contract Documents the information requested for interpretation.
- C. Subcontractor-Initiated and Supplier-Initiated RFIs
 1. Subcontractors and material suppliers submit RFIs through the Contractor. The Contractor reviews subcontractor- and supplier-initiated RFIs and submits them attached to an RFI form prepared, signed, and submitted by the Contractor.
 - a. RFIs submitted directly by subcontractors or material suppliers will be returned unanswered to the Contractor.
 - b. Review all subcontractor- and supplier-initiated RFIs and take actions to resolve issues of coordination, sequencing and layout of the Work.
- D. Requested Information
 1. Provide the information required to understand and analyze the circumstances causing the RFI and to prepare a clarification or direction as to how to proceed.
 2. The RFI may be returned unanswered if the provided information is insufficient.
- E. Unacceptable Uses for RFIs
 1. To request approval of submittals
 2. To request approval of substitutions

3. To request changes that involve change in Contract Time and Contract Sum
 4. To request different methods of performing Work than those indicated in the Contract Drawings and Specifications
- F. RFI Log
1. Prepare and maintain a log of RFIs
 - a. Furnish copies of the log showing outstanding RFIs if requested by the Engineer.
- G. Review Time
1. The Engineer will return RFIs to the Contractor within 10 calendar days of receipt.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 00120

BIDDING REQUIREMENTS AND CONDITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prequalification of Bidders
- B. Bidding Requirements and Responsibilities
- C. Proposal, Preparation and Submittal

1.2 RELATED SECTIONS

- A. Section 01455: Material Quality Requirements

1.3 REFERENCES

- A. United States Department of Treasury Circular
- B. Utah Administrative Code
- C. Utah Procurement Code
- D. Utah Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Prequalification Application (Including supporting and supplemental documentation (when applicable))
- B. Prequalification Guaranty Form (when applicable)
- C. Proposal
- D. Joint Venture (JV) Letter of Intent (when applicable)
- E. Confidential Financial Statement (when applicable)
- F. JV Agreement (when applicable)

- G. Corporate Resolution (when applicable)
- H. Request for Withdraw (when applicable)
- I. Proposal Guaranty Bond

1.6 PREQUALIFICATION

- A. Meet Department requirements for prequalification before submitting a proposal on projects where the total cost within the bidding schedule is greater than or equal to \$3 million. Refer to:
<http://www.udot.utah.gov/go/standardsreferences>
 - 1. Prequalification Applications (including supporting and supplemental documentation) must be received by the Secretary of the Prequalification Board no less than 15 calendar days before the scheduled bid opening.
 - 2. Prequalify at least once each year.
 - a. The Department may change a bidder's prequalification status based on the submission of additional favorable reports or evidence of unsatisfactory performance.
 - b. The prequalification amount limits bidding to individual contracts of a given size or for a particular type of work.
 - 3. Provide experience information on the Contractor's Prequalification Application and a confidential financial statement attested to by a Certified Public Accountant (CPA).
 - 4. Include a complete report of the bidder's financial resources and liabilities, equipment, work history, and personnel.
 - a. The Department establishes prequalification amount and work classification.
- B. Applicants may submit a guarantee of financial support provided by an affiliated but independent entity.
 - 1. Applicants must use the Department's guarantee form and submit it with their application.
 - 2. The guarantee may increase an applicant's adjusted equity by a maximum of 50 percent of the applicant's calculated adjusted equity in the formula.

1.7 JOINT VENTURE BIDDING

- A. Single Project Joint Venture:
 - 1. Two or more prospective bidders may prequalify and bid jointly on a single contract.
 - 2. Each business participating in a joint venture will file a Prequalification Application that includes a confidential financial statement attested to by a CPA.

3. Submit a letter of intent together as a joint venture to the Secretary of the Prequalification Board indicating the exact name of the joint venture and the designated administrative partners before submitting a joint venture proposal on a single project and at least four business days before the bid opening.
- B. Continuing Joint Venture:
1. Submit the following to bid jointly as a continuing joint venture on more than one contract, over a 12 month period, involving two or more prospective bidders:
 - a. A Prequalification Application and confidential financial statement of the joint venture audited by or attested to by a CPA.
 - b. A confidential financial statement audited by or attested to by a CPA for each member.
 - 1) Not required if the Department has a copy on file for the application year.
 - c. A copy of the joint venture agreement signed by each member of the joint venture and naming each person authorized to sign documents on its behalf.
 - 1) Submit a corporate resolution to accompany the agreement if a member is part of a corporation.
 - a) The corporate resolution will authorize the joint venture agreement and name the officers authorized to sign the joint venture agreement or contract on behalf of the corporation.
 2. The Department will treat the continuing joint venture as a new firm and determine prequalification limit on that basis.
- C. Complete the following under the joint venture designation before bid opening:
1. Bid bond
 2. Department Registration
 3. Department Contractor identification, password, and electronic signature
 4. Utah Contractor license

1.8 BIDDING DOCUMENTS

- A. The Department's Request for Proposal (RFP) will state or include the following:
1. Project location and description
 2. Bidding schedule of items for unit bid pricing
 3. Time for completing work
 4. Proposal guaranty amount
 5. Date, time, and place of bid opening

6. Basis for proposal comparison, if it is different than total cost
 7. Contract requirements not contained in the Department's Standard Plans and Specifications
 8. Disadvantaged Business Enterprise (DBE) requirements, when applicable
 9. Date, time, and location for mandatory pre-bid conference, when applicable
- B. Quantities may increase, decrease, or be eliminated under the contract.
- C. The Department pays for quantities of work as described in each pay item.

1.9 BID PROPOSAL

- A. A Proposal may be issued for combined projects or separately.
1. A proposal may be submitted either on the combined portions or on separate units of the combined project.
 2. The award of combined proposals or separate proposals is made to the advantage of the Department.
 3. The Department will specify which proposals may be combined.
- B. The Department considers conditional proposals only when specified in the advertisement.
- C. Submit proposal in the identical name used on the prequalification or according to a filed affidavit of change in business name or ownership.
1. Obtain the RFP, bidding information and instructions from the Department Web site. Refer to this Section, Article 1.10.
- D. The Department considers a proposal irregular and rejects the proposal as non-responsive if:
1. Not properly signed.
 2. Contractor is not prequalified, there is an insufficient amount of prequalification, or proposing work for an unauthorized work classification.
 3. Unauthorized additions, conditional or alternate bids, or other irregularities making the proposal incomplete, indefinite, or ambiguous.
 4. Added provisions reserve the bidder's right to accept or reject an award or to enter into a contract following award.
 - a. This does not exclude a proposal limiting the maximum gross award amount acceptable to any one bidder at any one bid opening. The Department selects which contracts to award.
 5. It Lacks required bid documentation escrow, when applicable.
 6. It is noncompliant with prequalification regulations.

7. It does not furnish a properly executed proposal guaranty according to this Section, 1.10.
8. There is evidence of collusion among bidders.
9. Does not comply with conditions of current special provision for certification of Affirmative Action for DBE.
10. It omits a unit price for an estimated pay item, except for authorized alternate bid items.
11. It is materially unbalanced.
12. It does not have a Status of Work Under Contract when required, reflecting the Contractor's current prequalification status or:
 - a. It is incomplete and improperly executed.
 - b. The sum of the amount of uncompleted work plus the estimate of the amount of proposed work exceeds the amount for which the Contractor is prequalified.
13. It does not meet material or bidding requirement of the invitation for bids.
14. It is received after date and time for bid opening.
15. It does not acknowledge receipt of or meet the requirements of addenda.
16. Award of additional work could impede or prevent timely completion of work currently under contract.
17. Failure to pay or settle outstanding labor issues, material bills or claims for a contract current at the time the proposal is issued.
18. More than one proposal for the same work is submitted from an individual, firm, or corporation under the same or different names.
19. Bid Guaranty received after date and time specified.
20. A mandatory letter of interest is not submitted.
21. Manual proposal submission does not contain both a signed hard copy and electronic version. Electronic media device (CD/Flash Drive) is blank, unreadable, not properly signed or does not contain the correct electronic bid items .txt file, such as Proj#_UDOTContractorID_bidopendate.txt.
22. Proposal is not submitted using Department's current EBS.
23. Proposer did not attend the mandatory pre-proposal conference. Utah Admin Code R33-7-201(1)(a).
24. Proposals received by the Department after the established due date and time will not be accepted. Utah Admin Code R33-7-402(1).
 - a. The Department considers submittals as part of the proposal, including prequalification documentation, in determining a responsive and responsible proposal.

E. A non-responsible determination will be conclusive unless the bidder appeals pursuant to the requirements of Part 16 of the Utah Procurement Code.

1. The Department may determine that a bidder is non-responsible and reject the proposal for the following reasons:
 - a. Prequalification information reveals a lack of competency and a lack of adequate machinery, plant, and other equipment.
 - b. Award of additional work could impede or prevent timely completion of work currently under contract.
 - c. Failure to pay or settle outstanding labor and material bills for a contract at the time the proposal is submitted.
 - d. Noncompliance with prequalification regulations.
 - e. Serious misconduct that would adversely affect the ability to perform future work.
 - f. Failure to reimburse the Department for monies on previously awarded contracts, including those where the prospective bidder is a party to a joint venture.
 - g. Contractor has unsatisfactory performance on previous or current contracts or serving probation for actions on another project.
 - h. Contractor is in default under previous contracts.
 - i. Debarred by the Department, or any State, or the Federal Government.
 - j. Contractor has failed to reimburse the Department for money owed on a previously awarded contract, including a contract where the prospective bidder was a party to a joint venture that failed to reimburse the Department.
- F. Bidders will verify that the combination of the bid amount and other contract work with the Department does not exceed the prequalification amount.
 1. The Department may determine the bidder to be non-responsive and refuse to award a contract if this combination does exceed the prequalification amount.
- G. Appeal in writing to the Department Deputy Director according to Utah Code Section 63G-6-801 through 806, as amended if the Department refuses to accept a proposal for the foregoing reasons.
- H. Submittal of a proposal is considered an affirmative statement that the bidder has performed the following:
 1. Examined the contents of the RFP.
 2. Visited and investigated the site and knows existing site conditions.
 - a. A reasonable site investigation includes investigating the project location, borrow sites, haul routes, and other locations related to the work to be performed.
 3. Investigated the nature and location of the work.

4. Satisfied as to the character, quality, and conditions that may be encountered and can affect work performance, budget, and other requirements of the RFP including the following:
 - a. Conditions bearing upon transportation, off-loading, handling, storage, and disposal of materials.
 - b. Availability of labor, water, electric power, and other utilities, and roads that provide access to and egress from the project.
 - c. Uncertainties of weather, river stages, irrigation channel flow, lake and reservoir levels, or similar physical ground conditions.
 - d. The type of equipment and facilities needed before and during work performance.
 - e. The character, quality, and quantity of surface and subsurface materials and obstacles that may be encountered.
 - 1) This information may be obtained from an inspection of the site, site drawings, specifications, and exploratory work made available by the Department.
 - 2) Department boring logs and other records of subsurface investigations are available for information purposes only and are not substitutes for the bidder's own investigation, interpretation, and judgment.
 - a) Boring logs and other records obtained from the Department are for design and estimating purposes only.
- I. Revise and save bid proposal using the current version of the EBS.
 1. Electronically transmit the proposal to the Department authorized repository before the time specified in the Notice to Contractors.
- J. A proposal may be withdrawn or revised before the time set for receiving proposals.
 1. Provide the request for withdrawal to the Department with a telephone call followed by documented electronic communications including a company authorized signature and the Department Contractor ID before the time set for receiving proposals.
- K. Immediately notify the Department of apparent errors, omissions, and ambiguities in the RFP.
- L. Request clarifications of the RFP documents by contacting the Project Manager no less than 14 calendar days before bid opening to allow time for a reply before submitting the proposal.

1. The Department responds to prospective bidder requests by certified letter or electronic communication before the specified time for bid opening.
 - a. The Department is bound only by written statements, representations, or descriptions of conditions and work.
 - b. Oral explanations or instructions are non-binding.
 2. Clarification requests received less than 14 calendar days before bid opening will be answered at the discretion of the Department.
- M. Failure to take the actions described and acknowledged in this Article does not relieve the bidder of the responsibility for estimating the difficulty and cost of successfully performing the work and from proceeding to successfully perform the work..
- N. Federal-aid projects are subject to Title 23 CFR Part 635.410, Buy America Requirements.
1. Check the appropriate box on the bid proposal indicating the intent to use steel or iron or both of 100 percent domestic supply or with some foreign supply.
- O. A proposal may be manually submitted if unable to electronically transmit.
1. A manually submitted proposal must include both a signed hard copy and an electronic version using an electronic media device (CD/Flash Drive).
 - a. The electronic media device must not be blank or unreadable and must contain the correct electronic bid items .txt file in the indicated format.
 - b. File format- Proj#_UDOTContractorID_proposalopendate.txt.
 - c. The signed hard copy takes precedence over a manually delivered electronic version in the case of discrepancies or initialed changes to unit prices or DBE commitment.
- P. Each person signing on behalf of any proposer certifies under penalty of perjury that to the best of his or her knowledge and belief that their organization complies with the following:
1. Bid prices have been arrived at independently without collusion, consultation, communication, or agreement with another bidder or competitor for the purpose of restricting competition.
 2. Quoted bid prices have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to another bidder or competitor before bid opening unless required by law.
 3. No attempt has been made or will be made by the bidder to induce another person, partnership, or corporation to submit or not to submit a proposal for the purpose of restricting competition.

4. The named Contractor has not, whether directly or indirectly, entered into an agreement, participated in collusion, or otherwise taken action to restrain free competitive bidding in connection with this proposal.
- Q. The Department will not consider a proposal for award nor will the Department make an award where there has not been compliance with this Article, except as follows:
1. The bidder must furnish with the proposal a signed statement that describes in detail the reasons the bidder cannot make the foregoing certification.
 2. The Executive Director or designee determines that such disclosure was not made for the purpose of restricting competition.
- R. The following does not constitute a disclosure within the meaning of non-collusive bidding:
1. A bidder has published price lists, rates, or tariffs covering items being procured.
 2. A bidder has informed prospective customers of proposed or pending publication of new or revised price lists for such items.
 3. A bidder has sold the same items to other customers at the same prices being bid.
- S. A proposal made by a corporation is considered authorized by the bidder's board of directors.
1. Authorization is defined as signing and submitting the proposal and includes the declaration of non-collusion on the part of the corporation.
- T. Manually or electronically signing the proposal certifies compliance with provisions of the following Non-Collusive Bidding Certification:

UTAH DEPARTMENT OF TRANSPORTATION NON-COLLUSIVE
BIDDING CERTIFICATION

"I declare under penalty of perjury under the laws of the United States and the State of Utah that neither I, nor to the best of my knowledge any member or members of my firm or company have either directly or indirectly restrained free and competitive bidding on this project by entering into an agreement, participating in collusion, or otherwise taking action unauthorized by the Utah Department of Transportation, with regard to competing for this contract."

- U. Each bidder and each person signing on behalf of a bidder certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief the named Contractor has registered with and uses a "Status Verification System" to determine the work eligibility status of an employee hired after July 1, 2009, pursuant to Utah Code Section 63G-12-302.
- V. Manually or electronically signing the proposal certifies compliance with provisions of this employment status verification certification.
- W. Manually or electronically signing the proposal demonstrates to the Department that the Contractor will have and will maintain a drug and alcohol testing program that complies with applicable provisions of the Utah Administrative Code 916-6 and Utah Procurement Code Section 63G-6a-1303 throughout the term of this contract.
 - 1. This requirement is also applicable to subcontracts under this contract that provide services or labor for design or construction.
- X. Apply and conform to Utah laws relative to the licensing of Contractors.
 - 1. A Contractor's license is required before submitting a proposal. Exception: A Contractor may submit a proposal on a Federal-aid highway project if they can become licensed in Utah before beginning construction (i.e., prior to notice to proceed).
 - 2. Failure to do so will result in forfeiture of award.
- Y. Obtain a commercial license to perform work in Utah.
 - 1. A license will be required to proceed with work.
 - 2. License requirements and application to perform heavy highway construction in the state of Utah requires the applicable license for the category of work being performed.
 - a. The Prime Contractor is required to hold a class E-100, General Engineering Contractor's license and the applicable license relating to their specific category of work being performed (such as an B-100 for General Building work).
 - b. A Sub-contractor is required to hold the applicable license relating to their specific category of work being performed. Licensing is governed by:

Utah Department of Commerce
Occupational/Professional Licensing
P O Box 145741
Salt Lake City, UT 84114-6741
(801)530-6628

- Z. The Department will not issue a notice to proceed without compliance with this Article.

1.10 BIDDING REQUIREMENTS

- A. Use the current version of the Department's Electronic Bid System (EBS) from the website. Refer to:
<http://www.udot.utah.gov/go/standardsreferences>.
1. Contact the Department's Construction Division for Contractor User ID and EBS training.
- B. Prepare and submit proposal using the Department's current EBS before the specified bid opening date and time.
1. Submit unit bid prices for the estimated quantities.
 - a. Research items that may be tax exempt and include this savings in the bid price.
 - b. Refunds of sales tax on contract items will be refunded to the Department.
 2. Complete electronic bid documents as instructed and specified within the current UDOT Electronic Bid System Manual.
 - a. Buy America Requirements
 - 1) Indicate whether using domestic or foreign steel.
 - 2) Refer to Section 01455.
 3. Confirm receipt of addenda.
- C. Indicate the choice of alternate items in EBS when the RFP permits a choice. EBS will not permit an additional choice.
- D. Provide the name and address of the individual signing the proposal as well as the following names and addresses, as applicable.

Table 1

Individuals Signing Proposal	
Type of Bidder	Names and Office Addresses Required
Individual	Individual and post office address
Partnership	Each Member of the Partnership and each post office address
Joint Venture	Each Member or officer of firms represented and each post office address
Corporation	Corporation name and corporate address

- E. Bidders submitting electronic or manual proposals must sign the Bid Report to certify they understand and are in compliance with terms and conditions of the contract.
 - 1. The Department will not accept a proposal with an unsigned Bid Report.
- F. Retain electronic bid documents until the project has been completed.
 - 1. Reference all manuals used to determine the bid proposal, including name, date, and publisher.
- G. Provide a proposal guaranty in the form of an electronic guaranty bond or provide evidence of securing a cashier's or certified check for not less than 5 percent of the total proposed amount made payable to the Utah Department of Transportation and issued from a surety company listed on the United States Department of Treasury Circular 570 before the specified date and time for bid opening.
 - 1. Use Department approved surety clearing house for electronic guaranty bond.
 - 2. Apparent low bidder delivers proposal guaranty in the form of cashier's or certified check within three calendar days of bid opening.

1.11 PROPOSAL OPENING

- A. Bids and proposals are publicly opened at the time indicated in the Invitation for Bids or RFP.

1.12 SUSPENSION, DEBARMENT, AND APPEAL

- A. Refer to Rule R907-67 of the Utah Administrative Code. Refer to: <http://www.udot.utah.gov/go/standardsreferences>. Suspension may apply when there is probable cause the Contractor has engaged in activity that would lead to debarment under Utah Admin. Code R907-67.
 - 1. The Department may suspend the Contractor from consideration for award of contracts.
 - 2. A Contractor who is suspended may not propose on Department contracts.
 - 3. Suspension may last for no more than three months unless an indictment has been issued, or information filed, alleging that the Contractor has engaged in criminal activity that would, if true, lead to debarment under Utah Admin. Code R907-67-1.
 - 4. If an indictment has been issued or information filed, suspension will last until completion of the Contractor's trial or the dismissal of charges.

- B. Refer to Utah Administrative Code Rule R907-67 (2013) Debarment of Contractors. Refer to: <http://www.udot.utah.gov/go/standardsreferences>. This rule includes subsections that address:
1. Reasons for Debarment
 2. Procedures for Debarment
 3. Status Pending Debarment
 4. Suspension from Consideration for Award of Contracts—
Indictments
 5. Length of Debarment
 6. Right to Appeal
- C. Issues, procedures, and other matters related to misconduct committed by contractors, consultants, owners, directors, managers, officers, fiscal agents of a Contractor or consultant, or other type of vendor that either does or seeks to do business with the Department which are not addressed by Rule R907-67 are governed as follows:
1. Utah Administrative Code Rule R33-9Refer to: : :
<http://www.udot.utah.gov/go/standardsreferences>
 2. Utah Procurement Code, Part 9, Cancellations, Rejections, and Debarment. Part 9 of the Utah Procurement Code. Refer to:
<http://www.udot.utah.gov/go/standardsreferences>.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 00515

CONTRACT AWARD AND EXECUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conditions for awarding a contract.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. Federal Uniform Guidance (FUG)
- B. United States Department of Treasury Circular 570
- C. Utah Procurement Code (UPC)
- D. Utah Administrative Code (UAC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Provide all submittals in this Section to the Director of Construction.
- B. Declaration of clerical or mathematical error when applicable. Refer to this Section, Article 1.6 paragraph D.
- C. Contract Bonds. Refer to this Section, Article 1.10.
- D. Executed contracts for Department execution. Refer to this Section, Article 1.11, paragraph A.
- E. Signed statement for QHI and actuarial statement. Refer to this Section, Article 1.11, paragraph B.

1.6 PROPOSAL CONSIDERATION

- A. The Department adheres to the requirements of the Utah Procurement Code (UPC), and applicable rules codified in the Utah Administrative Code (UAC) and the Federal Uniform Guidance (FUG) for soliciting, awarding and executing contracts.

1. Part 6 of the UPC applies to soliciting, awarding and executing "bids."
 2. Part 7 of the UPC applies to soliciting, awarding and executing Bid "Proposals."
- B. The Department publicly opens responsive proposals from responsible and prequalified vendors using the current version of the Electronic Bid System (EBS). The EBS compares bids and proposals on the basis of the summation of the products of the quantities and the unit bid prices.
1. The Department makes the results of the comparisons available to the public.
 2. The unit bid prices govern if a discrepancy exists between unit bid prices and extensions.
 - a) A signed hard copy takes precedence over a manually delivered electronic version in the case of discrepancies or initialed changes to unit prices or DBE commitment in this case.
- C. The Department reserves the right to reject any or all proposals, waive technicalities, or cancel a solicitation and re-advertise for new proposals, pursuant to the requirements of state and federal procurement law.
- D. The bidder can request withdrawal of a bid after bid opening by:
1. Submitting a notarized affidavit within 24 hours after bid opening declaring a clerical or mathematical error in bid preparation.
 - a) Submitting accompanying declaration with original work sheets used in bid preparation.
 - b) Describing specific errors in detail.
 - c) Verifying that error has a significant monetary effect in the amount of 3 percent of the bid or greater.
- E. Bidders may correct immaterial errors, and the Department may ask a bidder to clarify information included in a bid or proposal as allowed by the UPC and applicable rules and regulations after bids or proposals are opened.
- F. The Director for Construction makes the final determination of the withdrawal request.

1.7 CONTRACT AWARD

- A. The Department will award the contract to the lowest responsive and responsible bidder within 30 calendar days.
- B. The Department may withhold award beyond the 30 calendar days with the approval of the successful bidder.

- C. The bidder may withdraw the proposal without liability if the award is not made within 30 calendar days.
- D. The Department notifies the successful bidder by email as indicated with Contractor registration, followed by a certified letter mailed to the address shown on the proposal that the bid has been accepted and the contract has been awarded.

1.8 CANCELING THE AWARD

- A. The Department may cancel the award of any contract before a contract is executed pursuant to the requirements of the UPC, and the applicable sections of the UAC and the FUG without liability.

1.9 RETURNING PROPOSAL GUARANTY

- A. Proposal guaranties are released after the Department receives satisfactory contract bonds, all required certificates of insurance, and the fully executed contract between the Contractor and the bonding company.
- B. A Contractor is not released from its bidding or contractual obligation because of an alleged error in the preparation of the proposal or issues with any part of the contractual process unless the Department releases the surety guaranty.

1.10 CONTRACT BONDS

- A. The Department furnishes the required bond forms.
- B. Return fully executed bond forms to the Department as required by the UPC.
 - 1. Payment Bond secures the payment of the claims of laborers, mechanics or material suppliers employed on the work under the contract.
 - 2. Performance Bond guarantees the faithful performance of the contract.
- C. Each bond must be in an amount equal to 100% of the price specified in the contract.
- D. Underwriting Limitation is stated in the United States Department of Treasury Circular 570: Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies.

1. Only companies listed in the Department of Treasury Circular 570 in effect the year the contract between the Department and the Contractor is executed are acceptable.
 2. This list of companies is accessible through the U.S. Department of Treasury, Bureau of the Fiscal Service's website. A current link to the web page can be found at:
<http://www.udot.utah.gov/go/standardsreferences>.
- E. The Department may issue change orders that alter the terms of the contracts, extend deadlines, and change the scope of work without securing the consent of the surety or sureties on the contract bonds.
- F. The Department may terminate the contract and cancel all work under the contract if a Contractor's surety is unable to provide payment, unless the Department determines it is in the public interest to continue the work.
- G. Contractor may furnish cash bonds in the form of two cashier's checks, each in the amount of Contractor's bid amount as an alternative to the required payment and performance surety bonds.
1. The Department will hold the cash bonds in an interest bearing account and use the proceeds as needed for correcting non-performance or non-payment by the Contractor.
 2. The Department will return one half of the cash bond minus costs levied against either of the bonds to the Contractor upon release by the Engineer after physical completion of the work.
 3. The Department will release the remaining cash bond if no payment or performance claims arise for 90 calendar days after release by the Engineer after physical completion of the work.
 4. The Department will hold the cash bonds until existing non-performance or non-payment issues are resolved.
 - a. The Contractor accrues no liability during this time.
 5. The Department determines the need for withholding the cash bond.

1.11 EXECUTING AND APPROVING THE CONTRACT

- A. Awarded Contractor must return fully executed contracts, contract bonds, National Safety Rating Scores, and required certificates of insurance to the Department within 20 calendar days after the date of the notice of award.
1. The bidder can withdraw the proposal without penalty if the Department does not execute the contract within 30 calendar days after receiving requisite signed contracts, bonds, and insurance certificates.
 2. The contract is not considered effective or enforceable until fully executed by all parties.

- B. Qualified Health Benefit Plan-The Department will not issue a Notice to Proceed until the Contractor demonstrates to the Department that both the Contractor and its subcontractors have and will maintain an offer of qualified health insurance coverage for the Contractor's employees and the employees' dependents during the duration of the contract.
1. Contractors and subcontractors who fail to demonstrate to the Department that they have and will maintain an offer of qualified health insurance coverage for their employees and the employees' dependents during the duration of the contract are subject to penalties in accordance with Utah Administrative Rule, which may include termination of their contract.
 - a. For any subcontract valued at or above \$1,000,000 provide an actuarial statement of equivalency that they have and will maintain an offer of "qualified health benefit plan" to employees and dependents of employees as required by Utah Transportation Code 72-6-107.5.
 2. Refer to <http://www.udot.utah.gov/go/standardsreferences> for instructions on the process for Qualified Health Insurance Coverage.
 3. Contractor must provide two statements to "demonstrate" compliance with Section 72-6-107.5. Statements need to be signed originals and on company letterhead. Separate letters for each subsidiary, or DBA contracting with Department, are required.
 - a. Provide an original signed statement from the Contractor stating that they will maintain an offer of Qualified Health Insurance coverage as required by Utah Code 72-6-107.5 for the duration of any contract between Contractor and UDOT.
 - b. Provide a written statement of actuarial equivalency from:
 - 1) The Utah Insurance Department;
 - 2) An actuary selected by the Contractor or the Contractor's insurer; or
 - 3) An underwriter who is responsible for developing the employer group's premium rates.

1.12 MATERIALS GUARANTY

- A. Contractor may be required to furnish a written guaranty covering certain items of work for varying periods of time from the date of acceptance of the contract.
1. The Department specifies in the contract the work to be guaranteed, the form the Contractor will use to provide the guarantee, the time limit and other specific requirements of the guaranty.

2. Sign and deliver the materials guaranty to the Engineer before contract completion.
3. The required performance bond may be reduced upon contract completion to conform to the total amount of the contract bid prices for the items of work to be guaranteed. This amount continues in full force and effect for the duration of the guaranty period. Refer to this Section, article 1.10.

1.13 FAILURE TO EXECUTE CONTRACT

- A. The Department can cancel the notice of award and keep the proposal guaranty if the successful bidder does not execute the contract and file acceptable bonds and insurance certificates that prove coverage within 20 calendar days after the date of the Notice of Award.
- B. The Department may then award the contract to the next lowest responsive and responsible bidder or may re-advertise the work.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 00555

PROSECUTION AND PROGRESS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prosecution of the contract and progression of work

1.2 RELATED SECTIONS

- A. Section 00515: Contract Award and Execution
- B. Section 00777: Change Management
- C. Section 00820: Legal Relations and Responsibility to the Public
- D. Section 01282: Payment

1.3 REFERENCES

- A. Utah Transportation Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Statement of Actuarial Equivalency for information– Refer to this Section, Article 1.8.
- B. Request to Subcontract for approval – Refer to this Section, Article 1.8.
- C. Partnering Certificates for information for all required personnel before execution of the first month's construction estimate
- D. Full copy of executed subcontract for information when requested by Engineer

1.6 PRECONSTRUCTION CONFERENCE

- A. Contact Engineer within 14 calendar days after receiving Notice of Award and a minimum of 7 calendar days prior to work commencing on the project site to schedule the preconstruction conference.

1.7 NOTICE TO PROCEED

- A. Do not proceed with work until in receipt of Notice to Proceed from the Department.
- B. Notify the Engineer at least seven calendar days before beginning work.

1.8 CONTRACT SUBLETTING

- A. Obtain approval before subletting, selling, transferring, or assigning any portion of the contract.
 - 1. Provide a full copy of the subcontract agreement at the request of the Engineer.
 - 2. Provide an approved request for subletting for the following before beginning work when subletting or contracting for material hauling by truck, including from an owner-operator:
 - a. Hauling from any point or place within the project to any other point or place within the project.
 - b. Hauling material that is not the property of the contractor from a point or place on the project to a point or place outside of the project.
 - c. Hauling from a site of work location to a point or place on the project.
 - d. Hauling from a point or place on the project to a site of work location.
 - e. Hauling is performed by a commercial materials supplier or an independent third-party that places and incorporates the material into the project.
 - f. Hauling is performed by a Disadvantaged Business Enterprise (DBE) firm.
 - 3. An approved request for subletting is not required for the following when contracting for material hauling by truck, including from an owner-operator:
 - a. Hauling Contractor-owned materials from a point or place on the project to a point or place outside of the project.
 - b. Hauling is performed by a commercial materials supplier or a third-party and unloaded at a point or place on the project solely for the convenience of the supplier or transporter.
 - c. A DBE trucking company leases additional trucks.
 - 1) Provide lease agreement to the Engineer before work.
 - 2) Refer to Part XII Bid Conditions Disadvantaged Business Enterprise (DBE) Section F. Count DBE Participation Towards Goals for Performance.

- B. Sublet no more than 70 percent of the total contract bid amount.
 - 1. The Department considers an item as subcontracted in its entirety in computing the percentage of subcontracted work unless otherwise designated in the subcontract.
 - a. The Department uses the accumulated percentages of all approved subcontracts to determine that the maximum subcontracted limitation is not exceeded.
 - b. The Department uses the total dollar amount of the items subcontracted, divided by the total original contract amount to determine the amount of work subcontracted excluding:
 - 1) Items such as bonds, insurance, profit, and home office overhead that are being carried by the prime contractor are not considered to be part of the subcontracted amount
- C. Subcontracts do not relieve liability under the contract and bonds.
 - 1. Accept liability for any claims for damages or liability resulting from an act or omission of any person who carries out work as part of the contract with the Department, whether the working relationship is through a formal subcontract or carried out by an informal, unwritten agreement. Indemnify the Department for any damages or liability, including attorney's fees and court costs that may be incurred by such a person.
- D. Do not allow subcontracted work to begin until the request to sublet is approved by the Engineer.
 - 1. Demonstrate compliance using one of the following methods.
 - a. Provide appropriate documentation at the original execution of the contract.
 - b. Include appropriate documentation demonstrating compliance with health care requirement listed in Section 00515.
- E. Provide in subcontracts:
 - 1. A reduction in retained money equal to the percentage retained according to Section 01282.
 - 2. A statement describing the method of distribution of any adjustment due to price increases or decreases using applicable price adjustment specifications for items such as fuel, asphalt, cement, and common carrier rates.
- F. Supply all necessary resources to complete the contract regardless of the amount of work sublet.

1.9 LIMITATION OF OPERATIONS

- A. Minimize interference with traffic during performance of the work.
- B. Sunday and Category I Holiday Work
 - 1. Provide advance notice to the Engineer no later than noon on Wednesday, or four calendar days prior, whichever is greater before any Sunday or Category I holiday work, unless otherwise restricted in the contract.
- C. Category II Holiday Work
 - 1. Do not perform any work without approval except for repairing or servicing equipment, protecting work, maintaining or curing concrete, and maintaining traffic on Category II holiday.
 - 2. Provide notice to the Engineer no later than noon on the Wednesday, or four calendar days prior, whichever is greater before any Category II holiday work, unless otherwise restricted in the contract.
- D. Night Work
 - 1. Notify the Engineer at least five calendar days before starting night work.
 - 2. Provide adequate lighting for safely performing satisfactory inspection and construction operations.
 - 3. Control noise.

1.10 CHARACTER OF WORKERS

- A. Provide sufficient resources to complete all work according to the contract. Employ workers with the skills and experience necessary to perform the work.
- B. Remove from the project any employee who performs the work in an improper or unskilled manner or who is unsafe, intemperate, or disorderly.
 - 1. The Engineer may stop work for the Contractor's failure to remove the employee.
 - 2. Return these employees to the project only with the Engineer's authorization.
- C. The Engineer may stop work for the Contractor's failure to furnish suitable and sufficient personnel to perform the work.
- D. Employ a competent superintendent who is:
 - 1. Experienced with the work being performed
 - 2. Capable of reading and understanding the contract documents

3. Authorized to act as an agent for the Contractor
 4. Authorized to execute instructions and directions from the Engineer or authorized representatives.
- E. An authorized agent of the Contractor must be at the project site at all times that work is being performed.

1.11 PARTNERING

- A. Implement partnering according to the Partnering Field Guide. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
1. Failure to comply will result in 25 percent of the first estimate's Mobilization payment up to \$25,000 being withheld until all individuals have completed the required training.
- B. Share all partnering costs equally with the Department.

1.12 CONTRACT TIME

- A. Contract time begins 10 calendar days after the date of the Notice to Proceed unless otherwise specified.
- B. The contract documents define the time to complete the contract. Contract time is measured in either working days or calendar days or as a completion date contract.
1. The Department excludes the days elapsing between the effective dates of any orders of the Engineer to suspend and resume work that are not the fault of the Contractor
- C. The Engineer furnishes a Monthly Status of Contract Time Report, for working day contracts only, showing the number of days expended to date and the number of days remaining for substantial completion.
1. This statement is considered correct unless a documented protest explaining the Contractor's discrepancies with the Monthly Status of Contract Time report is submitted to the Engineer within seven calendar days of receipt.
 2. Failure to file a protest within the allotted time is acceptance of the time assessments provided by the Engineer in the Monthly Status of Contract Time.

1.13 WORK SUSPENSIONS

- A. The Engineer may give written notice to suspend all or any portion of the work for any reason at any time during the contract for the mutual benefit of the Department and the Contractor.
 - 1. Submit a request to the Engineer for a contract adjustment for suspensions or delays considered anomalous.
 - a. Submit the request within seven calendar days of the notice to resume work.
 - b. Contract adjustment is made only for requests submitted within the established time frame.
 - 2. The Department does not allow adjustments to the Contract to the extent that performance would have been suspended or delayed by any other cause or for which an adjustment is provided for or excluded under any other contract term or condition.
 - 3. Contract adjustment is made as specified in Section 00777 if both parties agree that the suspension:
 - a. Increased the cost or time required for the performance of the contract.
 - b. Resulted from conditions beyond control of the Department or the Contractor.
 - c. Was not caused by weather or seasonal or climatic conditions.
 - d. Was not due to failure to correct conditions unsafe for the workers or the general public
- B. Pursue a claim for additional compensation or contract adjustment if there is disagreement with this article.
- C. Maintain Traffic during a suspension
 - 1. Prepare the project for traffic flow during anticipated work suspensions.
 - 2. Maintain all required traffic control devices.
 - 3. The Department maintains temporary roadways and portions of the project during work suspensions.
 - 4. Resume maintenance for the entire project once work restarts.
 - 5. Repair or replace all work or materials lost or damaged during the suspension.
 - 6. Remove work or materials used for temporary maintenance and complete the project as though the work had been continuous and without interference.
 - 7. The Department pays for maintenance required by events beyond control during work suspensions at contract prices or as extra work.

1.14 STOP WORK ORDERS

- A. Stop Work Order:
 - 1. The Engineer can order work on a project stopped, wholly or in part, when it is determined a situation exists that requires that work be stopped until the situation can be corrected.
 - 2. The Engineer will provide a Stop Work Order, within 3 calendar days of verbal notification, that describes the reason for ordering work to stop and what actions need to be taken or how conditions need to change before work may resume.
 - 3. The Engineer will notify the Contractor when to resume work.
- B. Work may be stopped for any of the following reasons:
 - 1. Contractor's failure to comply with the contract.
 - 2. Contractor's failure to keep insurance coverage according to 00820 and this Section of the Standard Specifications,
 - 3. Contractor's failure to provide workers or equipment as previously mentioned in this Section of the Standard Specifications,
 - 4. Abandonment of work or default of contract upon notice as provided in this Section of the Standard Specifications,
 - 5. Unsuitable weather or soil conditions,
 - 6. Unusual conditions which affect the work and are not usually associated with the highway construction,
 - 7. Conditions exist that threaten the safety of the workers, public or nearby property.

1.15 PROJECT ACCEPTANCE

- A. Acceptance is achieved when work is conformant, found to be substantially and physically complete, and required documentation has been submitted.
- B. Substantial Completion
 - 1. Notify the Department two weeks prior to anticipated substantial completion date.
 - 2. Notify the Department the day of substantial completion.
 - a. Time charges stop.
 - 3. The Department will schedule a final inspection to:
 - a. Confirm that the requirements for substantial completion have been met and generate a punch list of corrective work required.
 - b. Determine that the project is not substantially complete and identify incomplete work necessary for attaining substantial completion.
 - 1) Time charges resume upon receipt of notification.

- 2) No additional notification of anticipated substantial completion is required unless otherwise specified.
4. Achieve substantial completion within the specified contract time. The Department deducts the sum specified in Table 1 from any money due for each calendar or working day, after the specified contract time including time extensions until substantial completion is attained.

Table 1

Schedule of Liquidated Damages		
Original Contract Amount		Daily Charge
From More Than	To and Including	
\$0	\$100,000	\$560
100,000	500,000	930
500,000	1,000,000	1,200
1,000,000	5,000,000	1,570
5,000,000	10,000,000	2,130
10,000,000	30,000,000	2,430
30,000,000		4,870

- C. Physical Completion
 1. Notify the Department one week prior to anticipated physical completion date.
 2. Notify the Department the day of physical completion.
 3. The Department will schedule a final inspection to:
 - a. Confirm that the requirements for physical completion have been met.
 - b. Determine that the project is not physically complete and identify incomplete work necessary for attaining physical completion.
 - 1) Time charges resume upon receipt of notification.
 4. Achieve physical completion no later than 30 calendar days after receipt of the final punch list. \$560 per day in disincentive will be deducted from any money due for each calendar day beyond the 30 calendar days limit necessary for physical completion.
- D. Achieve contract completion no later than 30 calendar days after receipt of notification of physical completion. The Department deducts \$100 per day in disincentive from any money due for each calendar day beyond 30 calendar days following receipt of notification of physical completion; including the final documents punch list or other Contractor obligation under the contract that remains unfulfilled.
- E. Partial Acceptance
 1. The Contractor may request acceptance of a portion of the work when the work is considered complete.

2. Partial acceptance neither voids nor alters any contract terms for remaining work.
- F. Continuing and completing the work after the contract time expires does not waive the Department's rights under the contract.

1.16 CONTRACT TERMINATION FOR DEFAULT

- A. The Department may declare the Contractor to be in default and terminate the contract if the Contractor:
1. Does not begin the work under the contract within the time specified.
 2. Does not perform the work with sufficient resources to secure the prompt completion of the work.
 3. Does not meet contract work requirements and neglects or refuses approved resolution
 4. Stops work; unless a stop work order has been issued by the Department.
 5. Does not resume stopped work within the time specified upon notification from the Department.
 6. Becomes insolvent, is bankrupt, or commits related acts.
 7. Is non-responsive to final third-party judgments.
 8. Makes an assignment for the benefit of creditors without the Department's approval.
 9. Is a party to fraud.
- B. The Department may declare the Contractor in default by written notice to the Contractor and the Surety advising them of the actions required for remedy.
- C. Comply with the written notice within 10 calendar days of receipt or the Department has full power and authority to terminate the contract.
- D. The Department may appropriate or use any or all materials at the project site and enter into another contract for completion of the work according to the terms and provisions thereof or use such methods as determined by the Department to complete the contract.
- E. All costs and charges incurred by the Department, including the cost of completing the work under the contract, are deducted from money owed or that may be owed the Contractor. The Contractor and Surety are liable and must pay the Department for the difference if the cost exceeds the sum that would have been payable under the contract.

- F. The rights and obligations of the parties will be the same as if the termination had been issued for public convenience if it is determined after termination of the Contractor's right to proceed that the Contractor was not in default.

1.17 CONTRACT TERMINATION FOR PUBLIC CONVENIENCE

- A. The Department may terminate the contract or any portion thereof after determining that for reasons beyond the Contractor's or the Department's control, the Contractor is prevented from proceeding with or completing the work and that termination is in the public interest.
- B. Reasons for termination may include but are not limited to:
 - 1. Executive Orders of the President or State Governor.
 - 2. National emergency that creates a serious shortage of materials.
 - 3. Orders from duly constituted authorities relating to energy conservation.
 - 4. Restraining orders or injunctions obtained by third-party citizen action resulting from national or local environmental protection laws or where the issuance of such order or injunction is primarily caused by acts or omissions of persons or agencies other than the Contractor.
 - 5. Court restraining orders based on acts or omissions of persons or agencies other than the Contractor.
 - 6. Fuel or asphalt cost adjustments according to Section 01282 that are in excess of the limits therein.
 - 7. Conditions determined to be in the best interest of the Department.
- C. Upon receipt of Notice of Termination, immediately:
 - 1. Stop work as specified.
 - 2. Do not enter into any further subcontracts or order materials, services, or facilities except as approved to complete any remaining portion of the contract.
 - 3. Terminate all subcontracts to the extent they relate to terminated work.
 - 4. Settle all outstanding liabilities and termination settlement proposals.
 - 5. Transfer title and deliver to the Department:
 - a. Complete and partially complete work and all materials produced or acquired before the Notice of Termination.
 - b. Completed or partially completed plans, drawings, information, and other property required to be furnished to the Department if the contract had been completed.
 - 6. Complete work not terminated.
 - 7. Coordinate a time and date with the Engineer to inventory materials obtained but not yet used for the project.

8. Take all necessary or directed actions to protect contract-related property that is in the possession of the Contractor and in which the Department has or may have an interest.
- D. The Department pays for:
1. All completed items of work as of that date at the contract pay item price when the Department orders termination of a contract effective on a certain date.
 2. Partially completed work either at agreed prices or by force account methods.
 3. Items that are eliminated in their entirety according to Section 00777.
- E. Support all claimed costs associated with contract termination with internal cost records that show actual costs.
1. The Department reserves the right to obtain and review all Contractor cost records associated with such a request.
- F. Termination of a contract or portion thereof does not relieve the Contractor of contractual responsibilities for the work completed or relieve the Surety of its obligation for and concerning any just claim arising out of the work performed.

PART 2	PRODUCTS	Not Used

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 00570

DEFINITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Definitions and acronyms used throughout Department Specifications.

1.2 RELATED SECTIONS

- A. Section 00777: Change Management
- B. Section 01280: Measurement

1.3 REFERENCES

- A. Code of Federal Regulations

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 ACRONYMS AND ABBREVIATIONS

- A. Interpret acronyms and abbreviations used in the Contract as follows:
 - 1. AAR Association of American Railroads
 - 2. AASHTO American Association of State Highway and Transportation Officials
 - 3. ACI American Concrete Institute
 - 4. AGC Associated General Contractors
 - 5. AI Asphalt Institute
 - 6. AIA American Institute of Architects
 - 7. AISC American Institute of Steel Construction
 - 8. AISI American Iron and Steel Institute
 - 9. AMRL AASHTO Materials Reference Laboratory
 - 10. ANLA American Nursery and Landscape Association
 - 11. ANSI American National Standards Institute
 - 12. API American Petroleum Institute
 - 13. APL Approved Products List
 - 14. ARA American Railway Association
 - 15. AREA American Railway Engineering Association
 - 16. AREMA American Railway Engineering and Maintenance-of-Way Association

17.	ARTBA	American Road and Transportation Builders Association
18.	ASCE	American Society of Civil Engineers
19.	ASLA	American Society of Landscape Architects
20.	ASTM	American Society for Testing and Materials
21.	ATMS	Advanced Traffic Management System
22.	AWPA	American Wood Preservers' Association
23.	AWWA	American Water Works Association
24.	AWG	American Wire Gauge
25.	AWS	American Welding Society
26.	CCTV	Closed Circuit Television
27.	CFR	Code of Federal Regulations
28.	DBE	Disadvantaged Business Enterprise
29.	DBS	Department Business System
30.	DMS	Dynamic Message Sign
31.	DTM	Digital Terrain Model
32.	EBS	UDOT's Electronic Bid System
33.	ESS	Environmental Sensor Sign
34.	EUSERC	Electric Utility Service Equipment Requirements Committee
35.	FHWA	Federal Highway Administration
36.	FSS	Federal Specifications and Standards (General Service Administration)
37.	GRC	Galvanized Rigid Conduit
38.	GSA	General Services Administration
39.	ID	Identification
40.	IMSA	International Municipal Signal Association
41.	ISO	International Organization for Standardization
42.	ITE	Institute of Traffic Engineers
43.	ITS	Intelligent Transportation System
44.	LFOT	Local Field Operations Test
45.	LRFD	Load and Resistance Factor Design
46.	MIL	Military Specifications
47.	MMF	Multi-Mode Fiber
48.	MUTCD	Utah Manual on Uniform Traffic Control Devices (This applies to all references to the MUTCD in Utah Department of Transportation 2017 Standard Specifications and Drawings, Supplemental Specifications and Drawings, Special Provisions, and Plan Sheets.) Refer to http://www.udot.utah.gov/go/standardsreferences for a link to the Utah MUTCD.
49.	NEC	National Electric Code
50.	NEMA	National Electrical Manufacturers Association
51.	NIST	National Institute of Standards and Technology
52.	NTPEP	National Transportation Product Evaluation Program

Definitions

53.	NVLAP	National Verification Laboratory Acceptance Program, (Bureau of Standards)
54.	OSHA	Occupational Safety and Health Administration
55.	OTDR	Optical Time Domain Reflectometer
56.	PM	Project Manager
57.	PCA	Portland Cement Association
58.	PDPL	Performance Data Products Listing
59.	PTI	Post-Tensioning Institute
60.	RMS	Ramp Metering Station
61.	RWIS	Roadway Weather Information System
62.	SAE	Society of Automotive Engineers
63.	SMF	Single-Mode Fiber
64.	SSPC	Society for Protective Coatings
65.	SWPPP	Storm Water Pollution Prevention Plan
66.	TMS	Traffic Monitoring Station
67.	TOC	Traffic Operations Center
68.	TTQP	Transportation Technician Qualification Program
69.	UDOT	Utah Department of Transportation
70.	UL	Underwriters Laboratory Inc.
71.	UPDES	Utah Pollution Discharge Elimination System
72.	USASI	United States of American Standard Institute
73.	USC	United States Code
74.	VIDS	Video Image Detection System
75.	VMS	Variable Message Sign
76.	WIM	Weigh in Motion
77.	WWPA	Western Wood Products Association

1.7 TERMS

A. Interpret terms used in the Contract as follows:

1. **Act of God** – Any cataclysmic phenomenon of nature beyond the Department and Contractor's control. Weather is not considered an act of God unless it can be shown conclusively that such weather could not have been anticipated as a normal hazard of the contract.
2. **Actual Cost** – Contractor's actual cost to provide labor, material, equipment owned or invoiced rental, and administrative overhead necessary for the work. Actual Cost excludes profit.
3. **Addendum** – Contract revision developed between advertising and opening of bid proposals.
4. **Advertisement** – The public announcement requesting proposals for specified work or materials.

5. **Approve or Approval** – Formal conditional determination by the Engineer that a particular matter or item is satisfactory for the project. Such determination may be based on requirements beyond those set forth in the contract and may reflect preferences by the Department. Items approved are considered to be as-if part of Department design.
6. **Authorize or Authorization** – Formal conditional determination by the Engineer that a particular matter or item designed or produced by others may be used. Such determination may be based on reasonable and accepted engineering principles typical for the work produced. Authorization does not relieve the Contractor from responsibility for negligent acts, errors, correctness of details, conformance to the contract, and the successful completion of the work.
7. **Award** – The Department's acceptance of a bid or proposal.
8. **Backfill** – Material used to replace, or the act of replacing material removed during construction.
9. **Bid** – Bid proposal. A proposer's written offer or proposal on Department furnished forms to perform stated work at the quoted prices.
10. **Bid Documentation** – All writings, working papers, computer printouts, charts, and data compilations containing or reflecting a proposer's information, data, or calculations used to determine the bid proposal. Bid documentation includes documents used to decide and apply:
 - Equipment rates
 - Overhead rates
 - Labor rates
 - Efficiency or productivity factors
 - Arithmetic extensions
 - Subcontractor and material supplier quotationsBid documentation excludes any Department documents provided to the proposer used to prepare the bid proposal.
11. **Bridge** – A structure, including supports, erected over a depression or an obstruction such as water, highway, or railway, and having:
 - a. A track or passageway for carrying traffic or other moving loads or utilities
 - b. A length measured along the center of roadway of more than 20 ft between under copings of abutments or extreme ends of openings for multiple boxes.

12. **Bridge Length** – The measurement taken at the centerline of the roadway between front faces of bridge abutments, spring lines of arches, or extreme ends of openings for multiple boxes; bridge length can also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.
13. **Bridge Roadway Width** – The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or in the case of multiple height of curbs, between the bottoms of the lower risers or if curbs are not used, between inner faces of parapet or railing.
14. **Certification** – A written document or affidavit officially declaring confirmation of a statement or information as being true, accurate, or genuine.
15. **Calendar Day** – Every day shown on the calendar, beginning and ending at midnight.
16. **Certificate of Compliance** – A certification, including a signature by a person having legal authority to act for the manufacturer, stating that the product or assembly to be incorporated into the project was fabricated according to the applicable requirements.
17. **Certified Test Report** – A test report from the manufacturer or an independent testing laboratory, including a signature by a person having legal authority to act for the manufacturer or the independent testing laboratory stating that the test results show the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all the specified tests.
18. **Change Order** – An order issued by the Department that alters the original contract and is agreed to by the Department and Contractor.
19. **Construction Limits** – The established boundaries within the highway right-of-way or construction easements that define the construction area.
20. **Contract** – Written agreement between the Department and the Contractor establishing the obligations of the parties for the performance of the work prescribed. The contract includes the following, all of which constitute one instrument:
 - a. Specifications and Plans
 - b. Materials Minimum Sampling and Testing
 - c. Notice to Contractors
 - d. Bidding Schedule
 - e. Measurement and Payment
 - f. Use of Minority or Women Owned Banks (federal project)

- g. Bid Conditions Disadvantaged Business Enterprise (federal project)
 - 1. Contract DBE Goal Percentage
 - 2. DBE Bid Assurance
 - h. E.E.O. Affirmative Action Requirements (federal project)
 - i. Specific E.E.O Opportunity Responsibilities (federal project)
 - 1. Apprentice Training Hours
 - j. Equal Opportunity (state project)
 - k. Title VI Appendix A & E
 - l. FHWA – 1273 (federal project)
 - m. Cargo Preference Act (federal project)
 - n. Wage Rates (when applicable)
 - o. Notice of Award
 - p. Notice to Proceed
 - q. Authorized contract time extensions
 - r. Change orders, directives and agreements required to complete the work in an acceptable manner
- 21. **Contract Amount (price component)** – The summation of the products of the quantities shown in the bid schedule multiplied by the unit bid prices for the items in the Contractor's bid proposal, but not including time.
 - 22. **Contract Bid Item** – A specific unit of work for which a price is provided in the contract. For projects that include Price + Time (P+T) bidding, Time is a contract bid item.
 - 23. **Contract Bonds** – The approved form of security, executed by the Contractor and the Contractor's surety or sureties, guarantying complete execution of the contract, including change orders, directives, and agreements, and the payment of all legal debts pertaining to the construction of the project.
 - a. **Contract Payment Bond** – The security executed by the Contractor and furnished to the Department to guaranty payment of all Contractor legal debts pertaining to the construction of the contract.
 - b. **Contract Performance Bond** – The security executed by the Contractor and furnished to the Department to guaranty completion of the work under the contract.
 - 24. **Contract Completion** – The day, determined by the Engineer, when all work specified in the contract is satisfactorily completed and all obligations of the Contractor under the contract are fulfilled.
 - 25. **Contract Time** – The substantial completion date or number of working days or calendar days allowed for substantial completion of the contract, including authorized time extensions.
 - 26. **Contractor** – The individual or legal entity contracting with the Department for performance of prescribed work.
 - 27. **County** – The County where the contracted work is located.

- 28. **Debarment** – Action taken by the Department or federal government pursuant to policies or regulations that prohibits a person or company from performing work on a public project.
- 29. **Delay** – An event, action, force, or factor causing work to extend beyond the specified contract time.
 - a. **Excusable Delay** – A critical delay that is beyond the Contractor's control, not the fault or responsibility of the Contractor, or could not have been foreseen by the Contractor, for which a time extension may be granted.
 - 1) **Compensable Delay** – An excusable delay caused by Department action or inaction, or under the Department's control, including delays resulting from change orders, differing site conditions, third party utility work suspensions caused by conditions beyond the control of the Contractor, lack of site access, and delayed shop drawing approval. The Department may grant additional time and compensation for such compensable delays as specified in Section 00777.
 - 2) **Non-compensable Delay** – Unforeseen and unanticipated excusable delay caused by acts of God, acts of public enemies, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, or delays not the fault of the Contractor or Department. The Department will not grant additional compensation for such delays.
 - a) **Concurrent Delay** – A non-compensable delay that occurs when both the Contractor and the Department independently delay work on critical path activities during approximately the same time period.
 - b. **Non-excusable Delay** – A delay that was within the Contractor's control, was the fault or responsibility of the Contractor, or could have reasonably been foreseen by the Contractor and for which there is no monetary compensation or time extension. Examples of such delay-causing events are normal weather or the failure by the Contractor to assign sufficient resources to the work.
- 30. **Department** – The Utah Department of Transportation

- 31. **Differing Site Conditions** – Subsurface or latent physical conditions at the project site that:
 - a. Differ significantly from those indicated in the contract.
 - b. Present unknown physical conditions of an unusual nature that differ materially from those normally encountered and generally recognized as inherent in the nature of the required work.
- 32. **Digital Terrain Model (DTM)** – A topographic model of the bare earth that can be manipulated by computer programs. The data file contains the spatial elevation data of the terrain in a digital format.
- 33. **Electronic Communication** – A communication transmitted through e-mail, or other electronic means where a hard copy can be produced.
- 34. **Engineer** – The UDOT Deputy Director, acting directly or through a duly authorized representative, usually the Resident Engineer, responsible for engineering and administration of the contract. A Consultant Engineer hired by the Department for construction project management is considered an extension of the Department and has the same responsibility and authority as a Resident Engineer.
- 35. **Equipment** – All machinery, tools, apparatus, and the fuels, lubricants, batteries, and other supplies and parts needed to use, operate, and maintain these items for use in constructing and completing the work.
- 36. **Extra Work** – Work not provided for in the contract, but found by the Engineer to be essential for the satisfactory completion of the contract within the contract's intended scope.
- 37. **Falsework** - A temporary structure that supports structural elements of concrete, steel, masonry, or other materials during their construction or erection.
- 38. **Force Account** – A method of payment for work performed by the Contractor at the Engineer's discretion calculated as specified in Section 00777.
- 39. **Forms, Formwork** - The enclosures or panels that contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms may in turn be supported on falsework.
- 40. **Geotextile** – Any permeable knitted, woven, or nonwoven textile material used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as an integral part of a man-made project, structure, or system.
- 41. **Highway**– A general term denoting a public way used by vehicles and pedestrians, including the entire area within the right-of-way.

42. **Holidays**

Table 1

Holiday Categories	
Category I	Category II
Martin Luther King, Jr. Day	New Year's Day
Presidents' Day	Memorial Day
Columbus Day	Independence Day
Veterans Day	Pioneer Day
	Labor Day
	Thanksgiving Day
	Christmas Day

Holidays that fall on a Saturday will recognize both the preceding Friday and the Saturday as holidays. Holidays that fall on Sunday will recognize both the Sunday and the following Monday as holidays.

- a. **Category I Holiday** – Holiday typically worked by Contractors.
 - b. **Category II Holiday** – Holiday typically not worked by Contractors.
43. **Inspector** – The Engineer's authorized representative assigned to inspect work and materials.
44. **Lane Rental** – A method to assess the Contractor rental fees for each lane, shoulder, or combination of lanes and shoulders taken out of service.
45. **Liquidated Damages** – A predetermined sum assessed the Contractor. This sum is not considered a penalty, but as liquidated damages due the Department by reason of added cost of engineering, supervision, contract administration, and other items for extra expenditures of public funds for the Contractor's failure to perform as required.
46. **Major Contract Item** – An individual pay item, or item added by change order, having a contract value in excess of five percent of the original contract amount.
47. **Notice to Proceed** – Written notice to the Contractor to begin the contract.
48. **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.
- a. **Surface Course** – One or more layers of a pavement structure designed to accommodate the traffic load, the top layer that resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called the wearing course.

- b. **Base Course** – One or more layers of specified material and thickness placed on a subbase or a subgrade to support a surface course.
- c. **Subbase** – One or more layers of specified material thickness placed on a subgrade to support a base course.
- 49. **Pay Item** – A specific unit of work where a price is provided in the contract and paid, subject to contract provisions, to the Contractor for the accepted quantities
- 50. **Physical Completion** – The day when all construction work required by, or incidental to, the contract is satisfactorily completed, including all punch list work, final cleanup, and demobilization and the Contractor's only outstanding obligation under the contract is submitting or processing documentation.
- 51. **Plan Quantity** – A designer generated quantity for a portion of the work designated as the pay quantity for the contract.
- 52. **Plans** – Contract drawings showing the location, type, dimensions, and details of the specified work.
 - a. **Standard Drawings** – Detailed drawings approved for repetitive use.
 - b. **Supplemental Drawings** - Approved additions and revisions to the Standard Drawings.
- 53. **Price + Time Bidding (P+T)** – A procedure for bidding price on contract bid items and time to complete project milestones.
- 54. **Probation** – Action taken by the Department pursuant to Department policies that prohibits a person or company from proposing on Department or Department administered projects.
- 55. **Project** – The specific section of the highway or other specific property where construction is to be performed together with all work constructed under the contract.
- 56. **Proposal** – A Proposer's written response to a Department request for proposals.
- 57. **Proposal Guaranty** – The security furnished with a proposal to insure that the proposer will enter into the contract if the proposal is accepted.
- 58. **Proposer** – An individual or individual's legal entity submitting a proposal in response to a request for proposals; also defined as an offerer in response to a request for proposals
- 59. **Request for Proposal** – A document used to solicit proposals including all other documents that are attached to that document or incorporated in that document by reference.
- 60. **Responsible Proposer** – A proposer capable in all respects of meeting all the requirements of a request for proposal; and fully performing all the requirements of the contract, including being financially solvent with sufficient financial resources to perform the work.

Definitions

- 61. **Responsive Proposal** – A proposal conforming in all material respects to the requirements of the request for proposal.
- 62. **Resources** – The labor, equipment, materials, and incidentals necessary to perform work on a contract bid item or other element of work.
- 63. **Right-of-Way** – A general term denoting land, property, or interest acquired for or devoted to transportation purposes.
- 64. **Roadbed** – The graded portion of highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.
- 65. **Roadbed Material** – Material in cuts, embankments, and embankment foundations from the subgrade down that supports the pavement structure.
- 66. **Roadside** – The areas between the outside edges of the shoulders and the right-of-way boundaries including unpaved median areas between inside shoulders of divided highways and areas within interchanges.
- 67. **Roadway, Road or Street** – That portion of a highway improved, designed, or ordinarily used for vehicular travel.
- 68. **Shoulder** – The portion of the roadway adjacent to the traveled way that supports base and surface courses.
- 69. **Site of Work** – As defined in Title 29 CFR Part 5.2 (I).
- 70. **Specifications** – The compilation of provisions and requirements for the performance of prescribed work, including any combination of the following:
 - a. **Special Provisions** – A unique specification or a modification or revision to the standard specifications applicable to an individual contract.
 - b. **Supplemental Specifications** – Approved additions and revisions to the Standard Specifications.
 - c. **Standard Specifications** – Specifications approved for general application and repetitive use.
- 71. **Stabilization** – Modification of soils or aggregates by incorporating materials that increases load-bearing capacity, firmness, and resistance to weathering or displacement.
- 72. **State** – The State of Utah acting through an authorized representative.
- 73. **Structures** – Buildings, bridges, box culverts, catch basins, cribbings, drop inlets, headwalls, manholes, overhead sign supports, retaining walls, and other similar features.
- 74. **Subgrade** – The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.
- 75. **Subgrade Treatment** – Stabilization of roadbed material.
- 76. **Subcontractor** – An individual or legal entity to which a Contractor sublets part of the work.

77. **Substantial Completion** – Substantially complete. The day as determined by the Engineer when all of the following have occurred:
- a. The public, (including vehicles and pedestrians), have full and unrestricted use and benefit of the facilities both from the operational and safety standpoint.
 - b. Successful completion of the LFOT, successful integration of devices to the Traffic Operations Center and active central communications to all devices.
 - c. All safety features are installed and fully functional, including, but not limited to, illumination, signing, pavement markings, all coats of striping paint, barrier, guardrail, impact attenuators, delineators, and all other safety appurtenances.
 - d. All remaining pay items in the contract are complete in addition to safety features. Only minor corrective work and replacement of temporary substitute facilities remains for physical completion.
 - e. The Contractor and Engineer mutually agree that all work remaining will be performed without lane closures, trail or sidewalk closures, and further delays, disruption, or impediment to the public.
78. **Substructure** – The system of bridge elements that support the superstructure. The substructure transfers the loads to the earth and retains material behind the supports. Substructure elements include abutments, bents, footings, piles, wingwalls, backwalls, etc.
79. **Superintendent** – The Contractor's authorized employee in responsible charge of work.
80. **Superstructure** – The system of bridge elements that spans the feature being crossed. The superstructure rests on the substructure. The superstructure includes the deck, parapets and girders, or other support elements (for example, trusses, arches, box girders).
81. **Surety** – The legal entity or individual, other than the Contractor, executing a bond furnished by the Contractor.
82. **Temporary Works** – Facilities that are generally designed by the Contractor and employed by the Contractor in the execution of the work and whose failure to perform properly could adversely affect the character of the contract work or endanger the safety of adjacent facilities, property, workers, or the public. Such facilities include but are not limited to falsework, forms and form travelers, cofferdams, shoring, water control systems, and temporary bridges.

- 83. **Time-Related Cost (time component)** – A bid item that identifies a daily value based on user costs or liquidated damages. Time value is the sum of the products of the time-related cost rates multiplied by the time bid by the Contractor to achieve the contract milestones.
- 84. **Traveled Way** – The portion of the roadway designated for the movement of vehicles, excluding shoulders and auxiliary lanes.
- 85. **Unbalanced Bid**
 - a. **Mathematically Unbalanced** – A bid containing lump sum or unit bid items that do not include reasonable actual costs plus a reasonable proportionate share of the proposer's anticipated profit, overhead costs, and other indirect costs.
 - b. **Materially Unbalanced** – A mathematically unbalanced bid that generates a reasonable doubt that awarding the contract to the proposer will result in the lowest ultimate cost to the Department.
- 86. **User Costs** – Costs incurred, directly or indirectly, by the traveling public due to construction activities.
- 87. **Unsuitable Material** - Material not meeting specifications, organic materials, materials that are soft, springy or otherwise yielding, frozen lumps, soils such as peat or bog, and over-saturated silts, clays, or sands whose water content prevents appropriate compaction.
- 88. **Utility** – All privately, publicly, or cooperatively owned lines, facilities, and systems for producing, transmitting, or distributing communications, power, heat, gas, oil, water, waste, and storm water not connected with the highway drainage, signal systems, and other products that directly or indirectly serve the public.
- 89. **Value Engineering Change Proposal** – A change proposed by the Contractor and considered by the Department intended to result in project cost savings to contract pay items without reducing the essential functions and characteristics of the project. Refer to Section 00725.
- 90. **Well-Graded Material** – Material having an even distribution of different particle sizes. This even distribution of particles of different sizes results in a dense mass upon compaction.
- 91. **Work** – The elements, activities, and incidentals necessary to complete a project (including labor, materials, equipment, and the interim products and stages attained in the course of reaching completion), and all alterations, amendments, or extensions made by change order or other written orders of the Engineer.

92. **Working Day** – Any calendar day, except:
- a. Contract designated holidays or days restricted in the contract.
 - b. Days when the Contractor is specifically required by the contract or letter from the Engineer to suspend operations through no fault of the Contractor.
 - c. Days when the Engineer determines that inclement weather or adverse conditions interfere with the progress of the work.
 - 1) When the Engineer determines that inclement weather prevents the Contractor from working for at least 50 percent of the normal working day.
 - 2) The day may be considered a working day exception even though conditions may improve and the major portion of the day could be considered suitable for operations if weather stops the Contractor's crew from beginning work at the normal starting hour and the crew is released as a result.
 - d. Submittals and notification requirements are based on a standard 5 day work week.
93. **Working Drawings** – Drawings produced by the Contractor that supplement the contract drawings to provide information not included in the contract documents but that is required to fabricate, erect, transport, or temporarily support the structure or structural elements in the completion of the work. Working drawings do not supersede the contract drawings.
94. **Written Permission of the Engineer** – A letter signed by the Engineer granting specific permission and outlining limitations of the permission.

PART 2	PRODUCTS	Not Used

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 00700

SCHEDULE AND NARRATIVE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provisions for scheduling the work and monitoring work progress.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS

- A. Activity – A discrete, identifiable task or event that has a definable start and stop date, and can be used to schedule and monitor the work.
- B. Activity ID – A unique, alphanumeric identification code assigned to an activity.
- C. Bar Chart – A graphic representation of a schedule without relationships. A timescale appears along the horizontal axis.
- D. Baseline Schedule – The original schedule created using a current version of Oracle's Primavera P6 to show the proposed timeline of the work.
- E. Critical Path - The longest continuous chain of activities for the project that has the least of total float of all chains. In general, a delay to an Activity on the critical path will delay the substantial completion date. The critical path is defined by the scheduling software as the longest path.
- F. Data Date – The date from which a schedule is calculated.
- G. Early Completion Schedule - A schedule showing an earlier substantial completion date than required by the contract and accurately reflecting a plan for completing the work.
- H. Free Float - The amount of time an activity can be delayed and not delay its successors.
- I. Milestone – An activity, with no duration, that is typically used to represent the beginning or end of the project or its interim stages.

- J. Original Duration – The estimated time, expressed in workdays, needed to complete an activity.
- K. Predecessor – An activity that precedes another activity.
- L. Qualified Scheduler – An individual who creates or reviews schedules using applicable software. This individual's sole duties do not need to be creating or reviewing schedules. The individual must have sufficient expertise to intelligently discuss the schedule to a level acceptable by the Engineer. Either party to the contract can choose to employ a qualified scheduler independent of the project team.
- M. Revised Schedule – A schedule prepared and submitted by the contractor that includes a major modification to the schedule activities, logic or durations from a previous baseline or update, not necessarily submitted at the regularly scheduled due date.
- N. Schedule Update – A baseline or prior schedule update that has been revised to reflect actual dates, durations, relationships, and sequencing of completed or progressed Activities. Activities that have not been progressed or are incomplete, planned dates, durations, relationships, and sequencing have been updated to reflect planned remaining Work.
- O. Successor – An Activity that succeeds another Activity. The start or finish date may be controlled by its predecessor.
- P. Total Float – The cumulative length of time activities can be delayed before they affect the project substantial completion date or a contractual milestone. Float is a shared commodity between both parties to the contract and not for the exclusive use or financial benefit of either party. Either party has use of the total float until it is depleted.
- Q. Work Breakdown Structure (WBS) – A method of organizing the work into hierarchical activities under separate headings. The WBS can be divided into geographic areas, similar types of activities, or sub-projects.

1.5 SUBMITTALS

- A. Provide a Preliminary Schedule and Narrative for review within 14 calendar days of Notice to Proceed.
 - 1. Show all planned activities from Notice to Proceed through the first 60 days of the project.
 - 2. Show the anticipated substantial completion date and projected major project milestones.
 - 3. Do not show work progress.
 - 4. Allow the Engineer 7 business days for review.

5. The Contractor may submit the Baseline Schedule subject to all baseline schedule requirements in lieu of the Preliminary Schedule.
 6. Provide all requirements listed for the baseline schedule in the submitted preliminary schedule
- B. Baseline Schedule and Narrative for review within 45 calendar days of Notice to Proceed if a preliminary schedule and narrative was provided. If a preliminary schedule and narrative was not provided submit a Baseline Schedule and narrative within 14 days of Notice to Proceed.
1. Use the Preliminary Schedule as the basis for the Baseline Schedule.
 2. Refer to this Section, Articles 1.7 and 1.9.
 3. Provide one color hard copy layout (.pdf format is acceptable) and one electronic Primavera file (.xer).
 - a. Format the hard copy to 11x17 landscape and include the table and Gantt chart views showing the full duration of the project.
 - b. Include the following columns in the table view in the order indicated:
 - 1) Activity ID
 - 2) Activity name
 - 3) Start Date
 - 4) Finish Date
 - 5) Original duration
 - 6) Total Float
 - 7) Longest path
 - c. Show the critical path in red color on the Gantt chart.
 3. Allow the Engineer 7 calendar days for review.
 - a. Resubmit the revised baseline schedule within 7 calendar days if the schedule is not authorized.
 4. Revise the authorized Baseline Schedule and resubmit for review according to this Section, Article 1.10.
 - a. A revised schedule need not be submitted at the regularly scheduled monthly submittal date.
- C. Schedule Update and Narrative for review each month during the Contract until physical completion.
1. Submit with the partial pay estimate.
 2. Refer to this Section, Articles 1.7 and 1.10

3. Provide one hard copy layout of the complete schedule (.pdf format is acceptable), one hard copy of the critical path (.pdf format is acceptable) and one electronic Primavera file (.xer format) of the current schedule update.
 - a. Include columns in the layouts as listed in the baseline schedule requirements.
 - b. Verify the schedule has been progressed using retained logic using the schedule function in Primavera P6 prior to submission to the Engineer with no further modifications made to the schedule following progression.
4. Allow the Engineer five business days for review.
 - a. Resubmit the revised baseline schedule within five business days if the schedule is not authorized.

1.6 BASELINE SCHEDULE PRE-SUBMITTAL MEETING

- A. The Engineer may require a baseline schedule pre-submittal meeting within 14 calendar days of receiving Notice of Award and before the submittal of the baseline schedule.
 1. The Resident Engineer, Contractor's Project Manager, Superintendent, qualified schedulers, and relevant field personnel attend the meeting.

1.7 GENERAL REQUIREMENTS

- A. The baseline schedule, narratives and updates allow the Contractor and the Department to jointly manage the work and evaluate work progress.
 1. The schedules also serve to evaluate the effect of changes and delays to the scheduled project completion.
- B. Create the construction schedule using the current version of Oracle's Primavera P6 Software and the critical path method.
- C. The Engineer's authorization of the preliminary schedule, baseline schedule, and schedule updates does not:
 1. Imply approval of construction methods or relieve the Contractor's responsibility to plan and execute the work and provide sufficient materials, equipment, and labor to guarantee the completion of the project according to the contract.
 2. Attest to the validity of assumptions, activities, relationships, sequences, durations, resource allocations, or any other aspect of the baseline construction schedule.
 3. Imply agreement that the project can be performed or completed as scheduled.

- D. Inform the Department when the Department's use of total float has a negative financial impact on the sequencing, use of resources, or any activity on the critical path.

1.8 PRELIMINARY SCHEDULE AND NARRATIVE

- A. Within 14 days of award of the Contract the contractor may submit a Preliminary Schedule and Narrative showing all planned activities from the Notice to Proceed through the first 60 days of the project.
 - 1. A preliminary schedule will have all the requirements listed in Article 1.9 for the appropriate timeframe scheduled.

1.9 BASELINE SCHEDULE AND NARRATIVE

- A. Provide a baseline schedule with baseline narrative.
 - 1. A disincentive of \$1,000 per week may be assessed beginning 60 days after Notice to Proceed until the Baseline Schedule and baseline schedule narrative is submitted if a preliminary baseline schedule and narrative was submitted
 - a. The disincentive period begins 14 days after Notice to Proceed if a preliminary schedule is not submitted
- B. Include in the schedule subcontracted work, delivery dates for critical materials, submittal and review periods, permits and governmental approvals, milestone requirements, utility work by others, third party coordination and no work periods.
- C. Meet the following requirements:
 - 1. Define a complete and logical plan, consistent with how the project was bid, that can realistically accomplish the work defined in the contract.
 - 2. Provide a sufficient number of activities to assure adequate project planning and allow for monitoring and evaluation of work progress.
 - a. Define activities to a level of detail satisfactory to the Engineer.
 - b. Include separate activities for cure time, major inspection points requiring preparation, submittal periods, and other time consuming activities.
 - 3. Show the critical path in the schedule beginning with Notice to Proceed and continuing through substantial completion
 - 4. Establish project calendars within the Primavera P6 software, do not use global calendars.
 - a. Name the calendars with the PIN followed by the calendar name such as 5-day with holidays, or 7-day.
 - 1) Include Holidays as non-working days as applicable.

- 2) Assign calendars consistently among similar activity types.
5. Define significant interaction points with the Department and other entities such as subcontractors, vendors and suppliers, utilities, local governments, and special service districts.
6. Designate the "Data Date" as the same day as the Notice to Proceed.
7. Clearly and uniquely define each activity name so that work is readily identifiable and progress can be measured.
 - a. For example, use the type of work, stationing, or structure numbers in the name.
8. Define the duration of each activity.
 - a. Limit the maximum duration of any activity to 21 calendar days unless otherwise approved by the Engineer.
9. Determine the duration for each activity by the time required to complete the work based on the anticipated production rate.
10. Identify the relationships between activities.
 - a. Demonstrate the overall approach to planning, scheduling, and executing the work.
11. All activities must have at least one predecessor, except for the start milestone, and one successor, except for the finish milestone.
12. Do not constrain activities unless required by contract or determined necessary by the Engineer.
 - a. Eliminate constraints by using additional activities, relationships, or calendars where possible.
13. Do not use negative lags.
14. Do not sequester project total float or free float through manipulating calendars, extending activities durations, or other methods.
15. Use resource loading if resource limitations may affect the prosecution of the work.
 - a. No request or claim for contract time extension based on resource shortages will be considered unless the baseline and subsequent schedule updates are resource loaded.
 - 1) Do not use any leveling resource schedule options when progressing the schedule.
16. Include milestones to define significant contractual events including, but not limited to, Notice to Proceed, substantial completion, physical completion, and coordination points with outside entities such as utilities and special service districts.
17. Define a WBS that organizes the project into geographic areas then area by work elements such as drainage, paving, or earthwork.
 - a. Assign activities consistently within the appropriate WBS.
18. Use calendars that reflect actual contractual constraints and restrictions as specified.

19. Set construction related Activities to task dependent.
 - a. Do not use resource dependent activities.
 20. Create separate activities for work that will be conducted by different subcontractors.
 21. Document and explain the Primavera settings used if different from the software default settings.
 22. Represent the full scope of the contract work in the schedule.
- D. Baseline schedule narrative:
1. Describe the construction philosophy supporting the approach to the work outlined in the baseline schedule.
 - a. Address the reasons for work sequences.
 2. Provide the justification for activities with durations exceeding 21 calendar days, usage of constraints, and non-typical activity settings.
 3. Include a description of all unusual calendars used in the schedule.
 4. Describe the approach used to apply relationships between activities such as physical or chronological relationships between work activities, sequencing due to crew or equipment resources, and timing of work based on limitations such as ROW, environmental, and third party utilities.
 5. Describe how typical weather days are accounted for in the schedule, such as being built into calendars or included in activity durations.
 6. Describe the critical path and identify challenges that may arise associated with the critical path.
 7. Describe how coordination with other entities will be handled.
 8. Include the production rates for all major activities.
 - a. The Department will not grant a time extension for labor inefficiencies if production rates and resource requirements are not provided in this Baseline Schedule narrative.
 9. Describe the work to be performed by all subcontractors.
 10. Certify that the baseline schedule represents how the work was bid or explain how it is different.

1.10 SCHEDULE UPDATE AND NARRATIVE:

- A. Provide a schedule and narrative update each month during the life of the Contract until physical completion to document work progress.
1. Submit a schedule update with the partial pay estimate.
 2. Comply with all applicable requirements of the Baseline Schedule.
 3. A disincentive of up to \$1,000 per week may be assessed beginning 7 days after the partial pay estimate is approved and until the schedule update and schedule update narrative are submitted.

- B. Show the following:
 - 1. Actual start and finish dates for completed activities.
 - 2. Actual start dates, percent complete, and remaining duration for activities in progress.
 - 3. Projected sequences of activities for future work.
 - 4. Revised relationships and durations for unfinished activities, if warranted.
 - 5. A well-defined critical path.
 - 6. The Data Date as one day after the closing date for the monthly partial pay estimate.
- C. Implement logic changes consistent with the retained logic method of scheduling to allow the out-of-sequence work to proceed if work is performed out of sequence.
 - 1. Show all activities as 100 percent complete in the final schedule submittal.
- D. The most recent authorized schedule update will become the schedule against which the next month's schedule update will be compared.
- E. Use retained logic when scheduling progressed activities.
- F. Schedule update narrative requirements:
 - 1. The work performed during the current estimate period.
 - 2. All current and anticipated deviations from the previous schedule update or baseline schedule for work performed to date.
 - 3. Description of the following:
 - a. The cause of each deviation that is on the critical path or has less than 20 days of float.
 - b. The impact or potential impact of each deviation to the work, planned durations, milestones, or project completion dates.
 - c. Mitigation performed to date.
 - d. Plans to mitigate or resolve the deviation.
 - 4. Discussion of deviations in the narrative does not relieve compliance with contractual requirements regarding notification and documentation of claims.
 - 5. Actions the Department needs to take and the timeline for actions to be taken to assist in avoiding or mitigating the problem.
 - 6. Reasons for and impacts resulting from all of the following that apply:
 - a. Added or deleted activities.
 - b. Changes in original durations.
 - c. Changes in relationships between activities.
 - d. Addition or deletion of constraints.
 - e. Changes to project calendars.
 - f. Changes to the Critical Path

- g. Revisions to actual start and finish dates as accepted in previous updates.
- 7. Provide status on pending items applicable to the schedule such as permits, easements, agreements, material procurements, change orders, and third party utilities if not in schedule
- 8. State that progress shown on the schedule update accurately represents work completed through the date indicated.
- 9. Describe the work planned to be accomplished during the next update period.

1.11 REVISED SCHEDULE AND NARRATIVE

- A. Revise the baseline schedule and schedule narrative in the event of any major change to the work.
 - 1. A revised schedule consists of the schedule and schedule narrative
 - 2. Examples of major changes are:
 - a. Significant changes in logic, activity durations, or methods of construction or changes to the critical path;
 - b. Addition, deletion, or revision of activities required by change order;
 - c. Approval of a submitted Value Engineering Change Proposal;
 - d. Delays in milestones or project completion;
 - e. Phasing revisions
 - f. If the Engineer determines that the schedule does not reflect the actual work.

1.12 MONTHLY PROGRESS MEETING

- A. Hold monthly progress meetings with the Engineer to review and discuss the status of the project.
 - 1. Discuss the critical path, changes in sequencing, or approach to work, change orders, and potential delays.
 - 2. Current and potential issues should be addressed with the intent of finding the most effective solutions to problems.
 - 3. Include the contractor's Project Manager, qualified scheduler, and appropriate field personnel.
 - 4. Create an action item list that describes who is responsible for resolving existing or pending issues and the date by which the issue needs to be resolved to avoid contract delays.

- B. Provide an updated four week look-ahead schedule each week.
 - 1. This schedule must:
 - a. Be consistent with the most current schedule update.
 - b. Show the activities and finish dates of the previous week's work, work in progress, and the next 4 weeks of anticipated work with a column for status/percent complete for each activity.
 - 2. Generate an electronic bar chart for the look-ahead schedule.
 - 3. The look-ahead schedule is intended to be a more detailed breakout of the schedule update.
 - 4. Use consistent activity names with the project schedule; provide related activity IDs as available.

1.13 EARLY COMPLETION SCHEDULE

- A. Additional compensation for delays due to actions attributed to the Department may be due if the baseline schedule and baseline narrative show that the work was planned to be completed early. Refer to Section 00777.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 00725

SCOPE OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provisions related to scope of work

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. UDOT and Utah AGC Partnering Field Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Contractor's Right of Entry Agreement with Rail Road for information–
Refer to this Section Article 1.10

1.6 CONTRACT INTENT

- A. The contract states the roles and obligations of the Department and Contractor regarding the construction, execution, and completion of work.
 - 1. Furnish all resources and incidentals required to complete the specified work.

1.7 RESPONSIBILITY FOR WORK

- A. General responsibilities:
 - 1. Complete work conforming to the contract
 - 2. Maintain traffic control
 - 3. Perform quality control
- B. Maintain, and take reasonable precautions to protect the items of work included in the contract against damage from all causes until project physical completion or written documentation of partial acceptance of the specific item of work has been received from the Department.

- C. Do not damage any feature within the site that is not part of the work.
 - 1. Do not damage adjacent property or other highways.
 - 2. Repair any damages to pre-existing condition.

- D. Rebuild, repair, restore, and make good all losses, injuries, and damage at no additional cost to the Department and according to approved resolution before project physical completion or written documentation of partial acceptance of the specific item of work
 - 1. The Department will consider the following situations exempt and will pay for rebuilding, repairing or restoring work when one or more of the following occurs:
 - a. Acts of God
 - b. Acts of public enemies
 - c. Acts of governmental authorities
 - d. Fires
 - e. Floods
 - f. Unusually severe weather
 - g. Vandalism
 - h. Damage caused by third parties where reasonable precautions to protect work have been taken.
 - 2. Take reasonable efforts to recover losses from third party insurance before requesting compensation from the Department for third party damages.

- E. Accomplish the following if work is suspended for any cause:
 - 1. Protect the project from damage.
 - 2. Provide for normal drainage.
 - 3. Erect any necessary temporary structures, signs, or other facilities.
 - 4. Maintain all newly established plantings, seeding, and sodding and protect new tree growth and other designated vegetative growth in an acceptable condition.

1.8 MAINTAINING TRAFFIC

- A. Keep roads open to traffic during the work and work suspensions or provide and maintain detour roads as specified or directed.
 - 1. Maintain all necessary accesses to areas such as parking lots, garages, businesses, residences, and farms.
 - 2. Exclude snow removal.

- B. The Department does not provide additional compensation for maintenance.

- C. Failure to maintain traffic is cause for the Department to take action to meet the requirements of this specification.
 - 1. The Department deducts its costs incurred in such actions from money due.

1.9 RESTORATION OF SURFACES OPENED BY PERMIT

- A. Allow individuals, firms, or corporations with authorized permits to enter the project to construct or reconstruct any utility service.

1.10 RAILWAY – HIGHWAY PROVISIONS

- A. The Department coordinates with the railway for new crossings or for existing crossings used during the work.
- B. Hold a pre-activity meeting at least 15 days before beginning any construction work on railroad right-of-way and give written notice to the Manager of Industry and Public Projects or equivalent position for the railroad company. Coordinate a work schedule based on the actual date both parties can begin work. Refer to contract documents for names of railroad companies.
- C. Give at least 48 hours verbal notice to the Manager of Track Maintenance or equivalent position for the railroad company responsible for the area the project is in before beginning work.
- D. Execute a Contractor's Right of Entry Agreement with the railroad company before performing any work within the railroad right-of-way.
 - 1. Obtain insurance required under the Contractor's Right of Entry Agreement.
 - 2. Provide a copy of the executed agreement to the Engineer.
- E. Determine the required cost of, including but not limited to railroad flagging, inspection, and cleanup crews. Include these costs in mobilization.
 - 1. The Department deducts payment under a construction accounting item for cost including but not limited to Railroad Flagging, Inspection, and Cleanup and pays the railroad directly for verified billings.

1.11 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS

- A. Do not interfere with the navigation of waterways when conducting work over, on, or adjacent to navigable waters.
- B. Comply with all conditions of permits from the U.S. Coast Guard or the U.S. Army Corps of Engineers.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 00727

CONTROL OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provisions regarding the Contract parties' relations in control of the work.

1.2 RELATED SECTIONS

- A. Section 00777: Change Management
- B. Section 01282: Payment

1.3 REFERENCES

- A. OSHA Safety and Health Regulations for Construction
- B. UDOT Safety and Health Manual
- C. Utah Procurement Code
- D. Utah Regulations for Legal and Permitted Vehicles

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Safety – Make documented evaluations available to the Department upon request from the Engineer. Refer to this Section, Article 1.19.
- B. Requests for Exception - Refer to this Section, Article 1.6
- C. Requests Alternate Methods and Products – Refer to this Section, Article 1.6

1.6 ENGINEER AUTHORITY AND DUTIES

- A. The Engineer decides all questions regarding the quantity, quality, and acceptability of materials furnished and work performed, work progress, contract interpretation, project acceptance, and acceptable contract completion.

1. The Engineer may reject work that does not comply with the Contract at any time, including after a payment has been made.
- B. The Engineer has the authority to stop the work, wholly or in part, by written order without liability to the Department if the Contractor does not:
 1. Correct conditions unsafe for the project personnel or the public.
 2. Comply with contract provisions.
 3. Comply with the Engineer's direction.
- C. The Engineer may suspend work wholly or partially for:
 1. Periods of unsuitable weather.
 2. Conditions unsuitable for the prosecution of the work.
 3. Any other condition or reason determined to be in the Department's interest.
- D. Requests for Exceptions
 1. The Engineer may waive contract requirements at a specific location and instance using the exceptions process if determined to be in the best interest of the Department.
- E. Requests Alternate Methods and Products
 1. The Engineer may approve equal or better product or method substitutions.
 2. Provide the Engineer all pertinent information to demonstrate equal or better for approval.

1.7 INSPECTOR DUTIES

- A. Department inspectors are authorized to inspect all work and materials furnished.
 1. Inspection may extend to the sites of the preparation, fabrication, or manufacture of the materials to be used.
 2. Inspectors are not authorized to alter or waive the contract provisions, issue instructions contrary to the contract, or act as foreman for the Contractor.
 3. Inspectors may determine when work is not in conformance with the contract.

1.8 CONTRACT CONFORMANCE

- A. Perform work and furnish materials to meet contract requirements.

- B. The Engineer decides the extent to which the work will be allowed to remain in place when a contract item does not meet contract requirements but is adequate to serve the design purpose.
 - 1. Provide the Engineer with a proposed resolution when work is deemed nonconformant with the contract.
 - 2. The Engineer may accept the proposed resolution or require the item to be removed and replaced.
 - 3. Work allowed to remain in place may require an adjustment to the unit price for the nonconformant work.
- C. The Department uses the specified pay adjustment factors for payment when the contract provides for acceptance of a pay item not complying fully with the minimum requirements.
- D. Remove, replace, or correct work before physical completion when a contract item contains defects, does not meet specified requirements, or results in work inadequate to serve the design purpose.
- E. Work performed contrary to Engineer's instructions, work beyond plan limits, or extra work performed without the Engineer's permission is excluded from pay consideration and may be ordered removed, restored, or replaced at the Contractor's cost.

1.9 WORK INSPECTION

- A. Provide information, assistance, and safe access to the Engineer for all parts of the work to obtain a complete and detailed inspection.
- B. Do not place permanent work nor cover any work without inspection and required testing by the Department.
 - 1. Remove and uncover portions of finished work as directed.
 - 2. Restore work to contract requirements after inspected.
 - a. The Department does not pay for additional costs to uncover, remove, replace the covering, or make good the parts removed, if the work is found unacceptable.
- C. Initial failure by the Engineer to reject defective or nonconforming work or materials either from lack of discovery or other reason does not prevent the later rejection when such defect or nonconforming work is discovered, nor obligate the Department to accept the final work or materials.
 - 1. The Department is not responsible for losses suffered due to necessary removals or repairs.

- D. The representative of any government agency, utility, or railroad company that pays a portion of the contract cost may inspect that portion of the work.
1. The right to inspect does not make that entity a party to the contract and does not interfere with the rights of parties to the contract.

1.10 REFERENCED DOCUMENTS

- A. All referenced documents are essential parts of the contract and a requirement occurring in one is binding as though occurring in all.
1. Referenced documents are complementary and provide and describe the complete contract.
- B. The governing ranking in case of a conflict is:

Dimensions		Information	
1.	Plan	1.	Special Provisions
2.	Calculated	2.	Sections 00100 to 01499
3.	Scaled	3.	Plans
		4.	Supplemental Specifications
		5.	Supplemental Drawings
		6.	Measurement and Payment
		7.	Standard Specifications
		8.	Standard Drawings

- C. Do not take advantage of apparent errors or omissions in the contract.
- D. Notify the Engineer promptly of errors or omissions in the contract so that necessary corrections and interpretations can be made.

1.11 CONTRACTOR LOGOS

- A. Do not use or attach permanent or temporary contractor logos or branding identification on any project physical features within the project limits.
1. Do not attach logos or branding identification other than those permanently attached to contractor owned vehicles, contractor owned, rented or leased equipment, and apparel.

1.12 UTILITIES

- A. Relocate or adjust utilities when specified.
 - 1. Use work procedures that consider the potential of inaccurate or inexact utility locations provided by utility owners, especially for underground installations.
 - 2. Cooperate with the utility owners to remove and rearrange underground or overhead utilities to avoid service interruption or duplicate work by the utility owner.
- B. Cooperate with the utility owners to adjust utility fixtures and appurtenances shown.
- C. Use work procedures that protect utilities or appurtenances that remain in place during construction.
- D. Notify the appropriate utility authorities of any service interruption resulting from breakage within the construction limits.
 - 1. Cooperate with authorities until service is restored.
 - 2. Obtain approval from the local fire authority and make provisions for continued service before working adjacent to fire hydrants.
- E. Adjust or relocate utility facilities or appurtenances found but not noted in contract documents when directed by Engineer.

1.13 COOPERATION BETWEEN CONTRACTORS

- A. The Department reserves the right to contract for and perform additional work at or near the work covered by the contract.
- B. Cooperate with other contractors working within the project limits. Conduct work without interrupting or inhibiting the progress or completion of work by other contractors.
- C. Each Contractor involved accepts all liability, financial or otherwise, in connection with their respective contract.
- D. Each Contractor protects and holds the Department harmless from any damages to partially or completed work from the presence and work of other contractors working within the same project limits.
- E. Coordinate and sequence the work with other contractors. Arrange, place, and dispose of materials without interfering with the operations of other contractors on the same project.

1.15 CONSTRUCTION SURVEY

- A. Perform the construction surveying necessary to properly control the work. Refer to Section 01721.

1.16 LOAD RESTRICTIONS

- A. Observe legal load restrictions when hauling equipment or materials on public roads beyond project limits.
 - 1. A special permit does not relieve the Contractor of liability for damage.
- B. Do not exceed legal gross weight limits on any public roads, structures, or on any component of the pavement structure excluding granular borrow.
- C. Suspend construction operations when load restriction violations are observed until the Engineer authorizes corrective measures.
- D. The Engineer contacts the appropriate law enforcement agency if overweight load violations are suspected when public roads are used to haul any type of excavation, borrow, backfill, base, or surfacing material.
- E. Comply with the following for materials imported to the job site such as asphalt, cement, concrete, or steel:
 - 1. Provide the Engineer with invoices showing the gross and net load weights.
 - 2. The Department withholds payment for material used in the project if invoices are not provided.

1.17 MAINTAIN THE WORK DURING CONSTRUCTION

- A. Maintain work included in the contract during construction until physical completion.
 - 1. Maintain traffic detour routes and project travel ways according to the Traffic Control Plan.
- B. The Engineer immediately notifies the Contractor of failure to meet these provisions.
 - 1. The Department maintains the project if unsatisfactory maintenance is not remedied within 24 hours after receiving notice.
 - 2. The Department deducts the entire cost to maintain the work from the money due or to become due the Contractor.

1.18 OPEN PROJECT SECTIONS TO TRAFFIC

- A. The Engineer may direct certain sections of work opened to traffic before completion or acceptance of the work.
- B. Directing a section of work does not constitute acceptance of the work or a waiver of any contract provisions.
- C. Maintain any section of roadway opened to traffic at the direction of the Engineer.
 - 1. Contractor is paid according to Sections 00777 and 01282 when the section of roadway opened to traffic is not the result of Contractor fault or inactivity.
- D. The Engineer gives notice establishing a time period for completing features of the work for which the Contractor has not met contractual milestone dates.
 - 1. Engineer may order all or a portion of the project opened to traffic if the Contractor does not complete or make a reasonable effort to complete the late work.
 - 2. Assume responsibility for maintaining the work and conduct the remaining construction operation with minimum interference to traffic.

1.18 RIGHT-OF-WAY

- A. The Department secures all necessary right-of-way before construction except as provided in the contract.

1.19 SAFETY

- A. Protect the health and safety of the Contractor, subcontractors, employees, the Department employees and the public.
- B. Employ a qualified safety person.
 - 1. Required qualifications
 - a. One of the following degrees or certifications:
 - 1) College degree in Occupational Safety & Health (OSH) related field
 - 2) Associate Safety Professional (ASP)
 - 3) Certified Safety Professional (CSP)
 - 4) Certified Industrial Hygienist (CIH)
 - 5) Construction Health and Safety Technician (CHST)
 - 6) Associate in Risk Management (ARM)

- 7) OSHA 500, or other nationally recognized OSH related field certification approved by UDOT Risk Management

2. Responsibilities

- a. Perform on-site safety inspections on a monthly basis. Refer to the UDOT Safety and Health Manual.
- b. Coordinate all safety related efforts with the on-site competent safety person.
- c. Cannot perform production-related responsibilities on the project.

C. Designate an on-site competent safety person.

1. Qualifications

- a. Must have taken and passed an OSHA 30 class or have equivalent training and education.

2. Responsibilities

- a. Perform daily documented pre-shift and post-shift work activity evaluations for the purpose of preventing work place accidents.
- b. Identify existing and predictable hazards and take prompt corrective measures to eliminate them.
- c. Oversee and correct any condition that is unsanitary, hazardous, or dangerous in any way to the health or safety of the project employees or the public.

PART 2	PRODUCTS	Not Used

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 00747

DISPUTE REVIEW BOARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Purpose, process, and selection of the Dispute Review Board (DRB) that is to be used as part of the Partnering process.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Letter of Intent to implement the DRB Option.
- B. The names of DRB members.
- C. Invoices for costs associated with DRB board for payment.

1.6 CONTRACT INTENT

- A. The DRB will assist in and facilitate the timely and equitable resolution of disputes between the Department and the Contractor in an effort to avoid animosity and construction delays and to resolve disputes quickly as close to the project level as possible.
- B. The DRB is established and operates as an independent and impartial body.
- C. The DRB provides a simple and rapid third party review of project disputes and leads to their resolution.
- D. The DRB process supplements and does not replace the partnering escalation process on the project.

1.7 GENERAL

- A. Submit Letter of Intent to exercise the DRB option prior to the Preconstruction Conference.
- B. The Department in conjunction with the Associated General Contractors of Utah (AGC) maintains a list of suggested DRB candidates experienced in construction processes, interpretation of contract documents, and resolution of construction disputes.
 - 1. The DRB members may be selected from this list or other qualified individual or individuals agreeable to both the Department and the Contractor.
 - 2. The Board member must be experienced in highway or transportation projects or both.
 - 3. DRB members must be neutral, act impartially and in the best interest of the project, and be free of any conflict of interest.
- C. The DRB will be made up of one or three panel members.
 - 1. The Contractor and the Department will jointly select the panel members prior to the Preconstruction Conference.
 - 2. The selection process may include interviews of prospective candidates.
- D. The DRB representatives must attend the Preconstruction Conference and participate in a monthly update with the project team.
 - 1. The monthly update may be conducted by phone or video conference.
- E. Costs associated with the DRB will be shared equally between the Contractor and the Department.
 - 1. Contract with DRB members.
 - 2. The Department will reimburse upon submittal of paid invoices.
- F. All meetings with the DRB will include representatives of both the Contractor and the Department.

1.8 DISPUTE RESOLUTION MEETING

- A. The Contractor or the Department may initiate a DRB meeting at any point in the partnering escalation process.
- B. Both parties will prepare a summary of the dispute and present it to the DRB.

- C. The information may be presented informally, with limited documentation, or formally, with presentations and exhibits to the DRB at a DRB dispute meeting.
 - 1. The Contractor and the Department decide prior to the DRB review meeting whether the material will be presented formally or informally.
- D. The DRB will return a decision within one week of the presentation.
- E. The DRB decision will be non-binding on either party, but may be used to determine resolution if the issue is escalated in the partnering escalation process.

PART 2	PRODUCTS	Not Used

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 00777

CHANGE MANAGEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provisions for making changes to the contract during execution of the contract
- B. Determination of additional time and compensation for changed and extra work.

1.2 RELATED SECTIONS

- A. Section 00570: Definitions

1.3 REFERENCES

- A. Partnering Field Guide

1.4 DEFINITIONS

- A. Claim – A request for compensation, time adjustment or both for a disputed change that has been escalated to the Department's Region Director and remains unresolved.
- B. Design Change – A revision to the contract issued by the Department directing the Contractor to proceed with new or revised work including an intended payment methodology for the new or revised work
- C. Exception - A waiver of one or more contract requirements which may include instructions or interpretations
 - 1. Exceptions do not involve adjustment to the contract value or time duration.
- D. Potential Change Order (PCO) – A potential risk that may result in a request for equitable adjustment in cost or time if said risk is realized.
- E. Request for Change Order (RCO) – A request by the Contractor to change the contract price, contract time, or both in response to unforeseeable conditions, design changes, and change directives.

- F. Significant Change in the Character of Work - Work that differs materially in kind, quantity, or nature from that involved or included in the original contract.
 - 1. Alteration or change can be significant changes to the character of work or by their effect cause other work to become significantly different in character.
- G. Value Engineering Change Proposal (VECP) - A proposed substitution of material or change to the work that may potentially result in cost or time savings and preserve essential functions and characteristics of the facility such as: service life, economy of operation, ease of maintenance, desired capacity, and safety.

1.5 SUBMITTALS

- A. Claims – Refer to this Section, Article 1.18, 1.20 and 1.23
- B. Exception (if applicable) – Request an Exception. Refer to this Section, Article 1.8
- C. Potential Change Order (if applicable) – Refer to this Section, Article 1.10
- D. Request For Change Order (if applicable) Refer to this Section, Article 1.11
- E. Value Engineering Change Proposal (if applicable) Refer to this Section, Article 1.16

1.6 CONTRACT MODIFICATIONS

- A. General
 - 1. The Engineer reserves the right to make, at any time during the work, changes in quantities and alterations in the work as are necessary to satisfactorily complete the project.
 - a. Only the Engineer has authority to direct a change to the contract.
 - b. Additional requirements from determinations, approvals, and authorizations of the Engineer are included in the contract and not considered significant changes in the character of work.
 - c. Changes in quantities and alterations do not invalidate the Contract nor release the Surety.
 - d. The Contractor agrees to perform the work as altered.

2. Changes and alterations may include among others:
 - a. Deleting any part of the work.
 - b. Increasing or decreasing quantities.
 - c. Altering specifications, designs, or both.
 - d. Altering the way the work is to be done.
 - e. Adding new work.
 - f. Altering facilities, equipment, materials, services, or sites, provided by the Department.
 - g. Ordering the Contractor to accelerate or delay the work.
 3. The contract sum or time can be adjusted only by written change order.
 4. Do not perform work considered a change to the contract without receiving authorization from the Engineer.
- B. Documents
1. Refer to Table 1 for documents and procedures that define the methods of modifying the contract.

Table 1		
Types of Contract Modifications		
Document	Procedures	Results
Exception	Requested by the Contractor. Evaluated by the Engineer.	An allowed deviation from contract plans and specifications at distinct location
Design Change	Issued by the Engineer.	The Contractor executes the change. The Contractor may submit a Request for Change Order if the payment methodology for the work change is not agreed to.
Potential Change Order	Prepared by the Contractor. Evaluated by the Engineer.	The Contractor submits the effects of the potential change on contract cost, contract time, or both.
Request for Change Order	Issued by the Contractor. Evaluated by the Engineer.	A change order is issued if the Engineer agrees to the terms and conditions of the request.
Change Order (CO)	Prepared by the Engineer. Agreed to and signed by the Engineer and the Contractor.	Documents changes in the contract price and time.
Value Engineering Change Proposal (VECP):	Prepared by the Contractor. Evaluated by the Engineer.	Change Order is executed if terms and conditions are agreed to. Cost difference is shared equally.

1.7 INSURANCE CLAIMS

- A. Determine whether insurance proceeds from Contractor's required insurance(s) are available to cover costs in connection with the item prior to filing any request for a change order.
 1. Pursue reimbursement of costs through insurance, if available.
- B. Notify the Department when filing an insurance claim within 20 calendar days of filing the insurance claim.
- C. Submit a Potential Change Order for all insurance claims filed.

1.8 EXCEPTION

- A. Request an Exception to the contract documents when a waiver of one or more requirements is being sought prior to the work being performed.
- B. The Engineer may grant a singular exception to a specification or drawing at their discretion if such waiver is deemed to not affect the value of the product.
 - 1. An exception does not change the requirements for the project as a whole.
 - 2. A change of the requirements for the project as a whole must be completed by a change order.
 - 3. Request an exception before beginning the affected work.
 - 4. Describe the exact specifications to which an exception is desired.
 - 5. Comply with the requirements in the authorized Exception.

1.9 NOTICE OF DESIGN CHANGE (NDC)

- A. The NDC is a design change issued by the Department that describes any desired change in the work and states the method of payment.
 - 1. Direction by the Engineer will be issued through an NDC.
- B. The issuance of a NDC does not necessitate the issuance of a change order.
 - 1. Proceed immediately with the work if the Department's proposed method of payment is acceptable.
- C. Submit a Request for Change Order (RCO) within 7 days of receiving the NDC if the Department's proposed method of payment is unacceptable.

1.10 POTENTIAL CHANGE ORDER (PCO)

- A. Notify the Engineer with a PCO that an event or situation resulting in a contract change is likely to occur.
 - 1. State if additional time or price or both may be requested if the event or situation occurs.
- B. Include at least the following in the PCO notification:
 - 1. Facts underlying the Potential Change Order and the reasons why additional compensation or time may be due.
 - 2. Basis that the work is not required by the Contract, if applicable.
 - 3. Particular elements of Contract performance for which additional compensation may be sought.
 - 4. Potential impact to the critical path affecting a Completion Deadline.

5. An estimate of the time within which a response to the notice is required to minimize cost or performance delay.

1.11 REQUEST FOR CHANGE ORDER (RCO)

- A. The Contractor may request a contract change for the following:
 1. An excusable delay to extend contract time and compensate for associated delay costs.
 2. Differing site conditions, when unforeseen condition or events, or new work is added that results in a request for additional compensation or time.
 3. A significant change in the character of the work when a quantity variation in a major item of work significantly changes how the work would be performed resulting in an increase or decrease in efficiency .
- B. A Request for Change Order (RCO) begins the administrative process for Change Orders.
- C. The RCO must reference a PCO or include the following:
 1. Detail the facts underlying the RCO, the reasons why additional compensation or time will be due and the date of event occurrence;
 2. Detail the basis that the work is not required by the Contract;
 3. Particular elements of Contract performance for which additional compensation may be sought;
 - a. Pay items that have been or may be affected by the change, condition, or event.
 - b. Labor or materials that will be added, deleted, or wasted by the change, condition, or event, and equipment that will be idled or added.
 - c. Existing or anticipated delays and disruptions in contract performance, procedure, or order.
 - d. Estimate of the time within which the Department must respond to the notice to reduce project cost, delay, or disruption.
 4. Number of delay days illustrated in a schedule impact analysis showing the impact of the delay-causing event on the project activity sequences and durations.
 5. All additional information contained within Article 1.12, 1.13, and 1.14 for which a RCO is being sought.
- D. Maintain and deliver to the Department upon request records for work performed which is believed to constitute changed or extra work.
- E. Review for request and determine if the request is justified if the RCO is based in whole or in part on a request by a Subcontractor.

- F. The right to receive reimbursement for costs incurred before the RCO delivery date if the RCO is delivered may be waived if the RCO Notice is delivered later than 7 days after the occurrence of an event is discovered or should have been discovered in the exercise of reasonable prudence.
 - 1. The right to receive an extension of the Completion Deadline with respect to a delay in the Critical Path that accrued before the delivery date of the written notice may also be waived.

1.12 EXCUSABLE DELAY

- A. It is the intent of this Article to define the process for determining contract time extensions and associated delay costs for excusable delays.
- B. Provide written notification to the Engineer within ten calendar days of the occurrence of an excusable event justifying the request for a time extension, as applicable.
 - 1. 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.
 - 2. Delays incurred during the ten days prior to notification may be compensable or excusable.
 - 3. Maintain daily records of labor, station locations, and equipment costs for operations affected.
 - a. Obtain the Engineer's acceptance with these records on a daily basis.
 - 4. Prepare and submit weekly written reports to the Engineer that contain:
 - a. Number of delay days.
 - b. Summary of all delayed operations, and operations that will be delayed, and the cause for delay.
 - c. Itemize all extra costs incurred:
 - 1) Document how the extra costs relate to the delay and how they are calculated and measured.
 - 2) Identify all affected project employees for whom costs are being compiled.
 - 3) Use actual internal cost records kept in the usual course of business to justify added costs.
 - a) Comply with generally accepted accounting principles.
 - 5. Meet with the Engineer weekly to compare the previous week's daily records with those maintained by the Engineer.
 - a. Resolve any disagreement over weekly delay costs with the Engineer.

- b. Provide written notice within ten calendar days documenting the disagreement between Department's calculations of weekly delay costs.
 - c. Failure to provide notification is interpreted as acceptance that Department records are accurate.
- C. Time will be added to the contract based on a mutually agreed to schedule impact analysis showing lost time attributable to the delay-causing event.
- D. Excusable Delay costs will be determined as follows:
 - 1. Direct Costs – Actual certified costs of the workforce and equipment idled by the delayed activity.
 - 2. Field Indirect Costs – Actual certified cost increases for job-site supervision and field office operating costs or other costs not directly associated with a particular work activity for the period of delay.
 - 3. Home Office Overhead – The markup allowed on all change orders includes the cost of home office overheads associated with that change in the project scope of work.
 - a. Demonstrate the following to be entitled to alleged additional compensation for under-absorbed home office overhead costs:
 - 1) Under absorption actually occurred, meaning there was less revenue overall in relationship to home office costs and that no replacement work was obtained.
 - 2) The under absorption was a direct result of the project.
 - 3) Specific replacement work could have been reasonably obtained were it not for the alleged delay.
 - b. Provide the following information supporting the claim additional costs:
 - 1) The previous five years audited financial statements that include as a minimum the following information:
 - a) Summaries of actual home office overhead costs.
 - b) Total revenues generated annually sorted by each project worked on during the year.
 - c) The amount of gain/loss earned for each active project during each year.
 - c. The amount will be calculated as shown below if additional payment for home office overheads is justified:
 - 1) Unabsorbed home office overhead will not be reimbursed for the first ten calendar days of the delay-causing event.

- 2) Home office overhead costs will be calculated from the eleventh calendar day of the delay-causing event through the events end if the project is between 0 and 90 percent complete.
 - 3) The following formula will be used to calculate home office overhead costs:

$$E = D [0.03(A)/C]$$

Where:

 - 0.03 = Allowed markup for home office overheads
 - A = Original contract value
 - C = Total contract duration in calendar days including approved time extensions
 - D = The agreed upon number of calendar days the project is delayed due to the delay-causing event minus ten
 - E = Total reimbursable amount for unabsorbed home office overhead
 - 4) Home office overhead will be reimbursed if the delay occurs after the project is 90 percent complete.
- d. The Department does not compensate for the following:
- 1) Profit.
 - 2) Loss of profit.
 - 3) Labor inefficiencies.
 - 4) Consequential damages, including but not limited to, loss of bonding capacity, loss of bidding opportunities, and insolvency.
 - 5) Any indirect costs or expenses.
 - 6) Attorney's fees, claims preparation expenses, or litigation costs.
4. The total reimbursable cost for an excusable delay is the sum of the daily agreed to costs for direct costs, field indirect costs, and unabsorbed home office overhead costs as computed according to this article for the duration of the delay.
- a. No other costs will be reimbursed.

1.13 DIFFERING SITE CONDITIONS AND NEW WORK

- A. This Article defines cost associated with changes due to differing site conditions, unforeseen condition or events, and new work that may result in a request for additional compensation or time.

- B. Immediately notify the Engineer verbally of all potential changes to the contract.
 - 1. Leave the site undisturbed and suspend work unless directed otherwise when differing site conditions on the project are encountered.
- C. Notification
 - 1. Provide the RCO within ten calendar days of when the change, condition, or event resulting in the request for a change order for additional compensation and time is discovered.
 - 2. Failure to provide written notification within ten calendar days of when the change, condition, or event is noticed may limit any contract adjustment, when warranted, to those costs or impacts incurred after written notification is received by the Engineer.
 - 3. Failure to provide required notice under this article constitutes a waiver for claim resulting from the alleged change, condition, or event.
- D. Continue the work unaffected by the alleged differing site conditions, change, condition, or event, to the extent possible under the contract.
 - 1. The Engineer will provide a written response within ten calendar days of receiving the notice to do one of the following:
 - a. Confirm the change, condition, or event and, when necessary, direct how the work will proceed.
 - b. Deny the change, condition, or event, and direct how the work will proceed.
 - c. Advise that there is not enough information to decide whether to confirm or deny the change, condition, or event and indicate what additional information is necessary for further review and the date by when it must be received.
 - 1) Any contract adjustments will exclude increased costs or time extensions resulting from failure to provide the requested information.
- E. The Engineer uses contract unit prices if they are representative of the work to be performed.
 - 1. Unit price work will be reimbursed at the rates established in the contract.
 - a. These rates include compensation for the actual work and associated field indirect costs, home office overheads, profit, and all other costs incidental to the work unless otherwise defined in the contract.
- F. Negotiated prices for changes to the contract work will be based on the estimate to do the work as validated by the Engineer. Support the price with a detailed cost estimate that includes the following information:

1. Estimated labor hours based on agreed upon productivity rates.
 - a. Use the actual cost of wages and benefits for the labor rates applied to the estimated man hours.
 - b. Include accounting records verifying these costs or make them available upon request of the Engineer.
2. Estimated material quantities based on agreed upon quantities.
 - a. Use actual material costs as verified by supplier estimates or invoices.
 - b. Use agreed to production rates for material produced on site.
3. Estimated Equipment hours based on agreed upon productivity rates.
 - a. Use either of the following for determining equipment costs:
 - 1) Rental rates obtained from the Rental Rate Blue Book for Construction Equipment according to this Section, article 1.16.
 - 2) Actual cost of the equipment to the Contractor based on internal equipment billing rates or actual rental rates supported by rental agreements for equipment applied to the estimated equipment hours.
 - a) Include accounting records substantiating these costs or make them available upon request of the Engineer.
4. A 15 percent markup will be paid on all expenses identified above.
 - a. This markup compensates the Contractor for small tools, home office overheads, profits, and incidental costs associated with the revised work.
5. The following cumulative additional markups, per issue, will be allowed on work performed by subcontractors:
 - a. 15 percent on first \$75,000; then
 - b. 10 percent on amounts exceeding \$75,000 up to \$250,000; then
 - c. 7.5 percent on any amount in excess of \$250,000.
6. No other expenses will be compensated unless approved by the Engineer.

G. The Department will adjust contract time for directed changes that extend the Critical Path, of the project.

1.14 SIGNIFICANT CHANGE IN CHARACTER OF WORK

- A. It is the intent of this Article to only address contract revisions where changes in quantities and alterations in the work are necessary to complete the work and result in a significant change in the character of the work.

- B. The Department adjusts the contract, excluding loss of anticipated profits, if the alterations or changes in quantities result in a significant change in character of work under the contract.
 - 1. Agree upon the basis for contract adjustment before beginning work.
 - a. The Engineer may order the work to proceed under the force account provisions if a basis for adjustment cannot be agreed upon.
 - 2. Adjustments may increase or decrease the unit price of an item.
- C. Loss of expected reimbursement, anticipated profits, or increased costs due to unbalanced allocation among the contract items will not be compensated.
- D. Failure to provide notification within ten calendar days of when the change, condition, or event is noticed may limit any contract adjustment, when warranted, to those costs or impacts incurred after notification is received by the Engineer.
 - 1. Failure to provide required notice under this article constitutes a waiver for any claim resulting from the alleged change, condition, or event.
- E. Unit price work will be paid at the original contract price when the total quantity of a major item of work, as defined by Section 00570, is within 25%, either higher or lower, of the original bid quantity, and the alterations or changes in quantities do not represent a significant change in the character of work to be performed under the contract.
 - 1. An adjustment for a decrease in quantity below 75 percent of the contract quantity is limited to the actual quantity of work performed.
 - a. Fixed costs in the original contract may be considered when establishing the adjustment.
 - b. An adjustment in price may be made to the contract at the request of either party.
 - 2. A price adjustment for an increase in quantity applies only to that portion in excess of 125 percent of the original contract quantity.
 - a. Fixed costs in the original contract price are deemed recovered by payment made for 125 percent of the contract quantity and excluded from any adjustment to that portion in excess of 125 percent of the original contract quantity.
 - b. An adjustment in price may be made to the contract at the request of either party.
- F. The Department will adjust contract time for directed changes that extend the critical path of the project.

1.15 VALUE ENGINEERING CHANGE PROPOSAL

- A. Cost savings resulting from a Value Engineering Change Proposal (VECP) offered by the Contractor and approved by the Department will be equally shared.
- B. Complete the contract as bid if a VECP is rejected.
- C. Include the following information and materials with each proposal:
 - 1. A statement that the submission is a VECP.
 - 2. A description of the existing work and the proposed changes for performing the work. Discuss the comparative advantages and disadvantages of each.
 - 3. A complete set of plans and specifications showing proposed revisions to the original contract.
 - 4. A detailed cost estimate for performing the work under the existing contract and under the VECP.
 - 5. The time frame within which the Department respond with a decision.
 - 6. A statement of the probable effect the VECP will have on the contract completion time.
 - 7. A description of any previous use or tests of the proposal, conditions, result, dates, project numbers, and the Department's action on the VECP if previously submitted.
- D. Provide additional information requested by the Department in a timely manner.
 - 1. The Department notifies the Contractor within five business days when there is insufficient review time for a response.
 - 2. The Department may consider a non-compensable delay adjustment to the contract based on the additional review time necessary and its effect on the schedule.
- E. Requirements
 - 1. VECPs apply only to the current contract and become property of the Department regardless of their approval.
 - 2. The Department only considers VECPs that meet the following conditions:
 - a. Impose no restrictions on use or disclosure not protected by rights provided by law with respect to patented materials or processes such as
 - 1) Preventing the Department from duplicating or disclosing any data necessary to use the VECP.
 - 2) Preventing the Department from the general use on other contracts.

3. The Department may reject a VECP that requires excessive review, evaluation or investigation, or that is inconsistent with project design policies or criteria, or at the discretion of the Engineer.
- F. A claim for additional costs or delays including development costs, loss of anticipated profits, or increased material or labor costs will not be permitted if the VECP is rejected or if additional information was requested and not submitted.
- G. The Department does not consider savings generated by contingency items when it is reduced as part of a VECP unless it can be tied to a reduction in contract time.
- H. Withdrawal of all or part of any Value Engineering Order proposal is allowed any time before Approval by the Department.
- I. The Department pays by change order for VECPs that produce a cost savings approved in whole or in part.
 1. The change order incorporates changes in quantities of unit bid items or new agreed price items, as appropriate.
 2. The Department pays for the revised work directly and pays 50 percent of the savings between cost of the revised work or substituted material and the original bid price.
 3. The Department does not reimburse costs to develop, design, and implement the VECP.
 4. Subcontractors cannot submit VECPs.

1.16 FORCE ACCOUNT

- A. Work on a force account basis may be required if an agreed upon price cannot be negotiated for changed or added work or for the convenience of the Department.
 1. Costs reimbursed according to this article are considered full and complete compensation for the work performed.
- B. A 15 percent markup will be paid on all labor, material, equipment and direct expenses, including bond.
 1. This markup compensates for small tools, field overheads, home office overheads, profits, and incidental costs.
- C. Labor will be reimbursed at the actual sum of unburdened wages plus 60%.
 1. Provide daily field records showing the labor hours charged to the force account work.
 - a. Obtain approval of these records daily.

2. Include accounting records verifying these costs or make them available to the Engineer upon request.
 3. The Department may pay the actual cost of wages plus burden if the Contractor can demonstrate the actual cost.
- D. Materials will be reimbursed at the actual cost of installed materials as verified invoices and accounting record.
1. Make records available to the Engineer upon request.
 2. Provide daily field records showing the materials installed as part of the force account work.
 - a. Obtain approval of these records daily.
- E. Compensation for Equipment
1. The Department will pay either of the following:
 - a. Actual cost of the equipment based on internal equipment billing rates or actual rental rates supported by rental agreements.
 - 1) Provide accounting records substantiating these costs.
 - b. Hourly rates for machinery or special equipment, excluding small tools, authorized by the Engineer.
 - 1) Hourly rental rates are determined by the monthly rental rate found in the Rental Rate Blue Book for Construction Equipment divided by 176.
 - 2) The total hourly rates have been computed from equipment costs currently in effect and do not include costs for operating personnel.

Obtain this publication through:

Equipment Watch

1735 Technology Drive, Suite 410

San Jose, CA 95110-1313

Phone: (800) 669-3282

Fax: (800) 224-3527

Refer to <http://www.udot.utah.gov/go/standardsreferences>.

3) The rates require adjustment by a Regional Factor and a Depreciation Factor with operating and standby rates established as follows:

- a) Operating Rate – Hours the equipment is actually in use.
 - (1) This includes ownership and operating costs adjusted for depreciation and region factors.

- b) Standby Rate – Compensation for equipment required to be at the work site but not operating.
 - (1) This rate is 50 percent of the adjusted ownership and operating costs computed above.
 - (2) The duration of allowable standby time must be approved in writing by the Engineer with a maximum of eight hours per day or 40 hours in a week.
- 4) The Department uses the shown capacity that is closest to the manufacturers when the manufacturer's rated capacity falls between those shown in the Rental Rate Blue Book for Construction Equipment.
- 5) Agree upon all rates in writing before beginning work.
- 6) Obtain approval from the Engineer for any equipment rental rates not provided before the start of any force account work.
- 7) The Department allows move-in and move-out transportation cost for a piece of equipment not available on the jobsite, if the particular piece of equipment is not moved onto the job under its own power.
 - a) The Department allows hourly operating rate for equipment moved to the site under its own power.
 - b) The Department pays these charges only once for any particular piece of equipment except in unusual circumstances that must be justified in writing and agreed to by the Engineer.
- 8) The equipment may be rented from a local source when the required equipment is specialized and not available in inventory or is in the available inventory but not on the project site.
 - a) Submit the rental or lease agreement to the Engineer for approval where the rental rate charged exceeds the rate determined by the Rental Rate Blue Book for Construction Equipment.
 - b) Move-in and move-out costs for equipment owned may be considered when comparing rental costs of equipment obtained from local sources when the equipment is to be used less than a week.

- c) This option is only allowed when the cost of locally rented equipment is less than using equipment owned, including move-in and move-out charges.
 - d) Rentals must be supported by a cost analysis indicating the method used was the least expensive.
 - e) The Department reimburses for such equipment based on the Rental Rate Blue Book for Construction Equipment if equipment rented is of a type that is owned and the rental costs exceed that allowed by this article.
 - 2. The Department does not pay for pickup trucks used solely for transportation.
 - 3. Provide daily field records showing the equipment hours charged to the force account work.
 - a. Obtain approval of these records daily.
 - 4. Provide certified accounting records verifying these costs.
- F. Subcontract work will be reimbursed in the same manner as described in this Article above.
- 1. The Department allows the following cumulative markups, per issue, on force account work performed by subcontractors:
 - a. 15 percent on first \$75,000; then
 - b. 10 percent on amounts exceeding \$75,000 up to \$250,000; then
 - c. 7.5 percent on any amount in excess of \$250,000.
 - 2. Provide daily field records showing the subcontract labor, material, and equipment charged to the force account work. The Engineer must review and approve these records daily.
 - 3. Provide certified Accounting records verifying these costs

1.17 CONTRACT ADJUSTMENT CLAIMS

- A. Notify the Engineer of intent to file a claim for additional compensation for work or material before beginning or continuing the affected work.
 - 1. Follow the notification requirements for differing site conditions, changes, and requests or claims for additional compensation.
 - 2. The Engineer responds for differing site conditions changes and requests or claims for additional compensation.
- B. Work closely with the Engineer during notification, review, and evaluation to resolve the contract question and avoid further claims.

- C. A claim for additional compensation is waived if the Engineer is not notified or is not afforded an opportunity for strict accounting of actual costs.
- D. Submit claim with enough detail to enable the Engineer to understand the basis for entitlement and the resulting costs. Include the following information with each claim:
 - 1. A detailed statement providing all necessary dates, locations, and items of work affected by the claim.
 - 2. The date on which actions or conditions resulting in the claim occurred or became evident.
 - 3. The specific contract provisions that support the claim and a statement of why they support it.
 - 4. Identification of pertinent documents and the substance of any relevant verbal communications relating to the claim.
 - 5. A statement whether the additional compensation or extension of time is based on contract provisions or an asserted breach of contract.
 - 6. Include the following for time extension or compensation for delay requests:
 - a. A schedule impact analysis that clearly defines the delay.
 - b. The specific reasons a time extension should be granted.
 - c. Documents and reports specified for determining compensation and contract time extension for excusable delays under this Section.
 - 7. The exact amount of additional compensation sought and a breakdown of the cost into the following categories:
 - a. Direct labor
 - b. Direct materials
 - c. Direct equipment
 - 1) Do not exceed actual internal costs on rates claimed for each piece of equipment.
 - d. Field indirect costs
 - e. Home office overhead
 - f. Subcontractor's claims
 - 1) Provide the same level of detail as specified in contract documents for any subcontractor's claims.

8. Certification – Submit a statement to the Engineer containing the following language:

Under the penalty of law for perjury or falsification, the undersigned,

_____	_____	_____
Name	Title	Company

hereby certifies that the claim for extra compensation and time, if any, made herein for work on this contract is a true statement of the actual costs incurred and time sought, and is fully documented and supported under the contract between the parties.

Dated _____ signed _____
Subscribed and sworn before me this _____ day of _____
Notary Public _____
My Commission Expires _____

- E. Failure to either submit information and details as specified in this article for any claim or failure to submit any claim before the date of contract completion constitutes a waiver of the claim.

1.18 CLAIMS RECORD KEEPING

- A. Maintain complete records electronically of all costs and additional time incurred for any alleged claim.
- B. Permit the Engineer access to those records and any other records as required to determine the facts or contentions involved in the claim.
- C. Retain all records for a period of not less than three years after final payment.

1.19 CLAIMS AUDITING

- A. All claims filed against the Department are subject to audit at any time following filing the claim.
- B. The Department or an auditor under contract with the Department may conduct the audit.
 - 1. The audit may begin at any time during the life of the contract or 20 calendar days after notice is provided if more than 60 calendar days after the project acceptance date of the contract have elapsed.

- C. Provide adequate facilities acceptable to the Engineer for the audit during normal business hours.
 - 1. Cooperate with the auditors.
- D. Failure to maintain and retain sufficient records to allow the auditors to verify all or a portion of the claim or to permit the auditor access to the books and records constitutes a waiver of the claim and bars any recovery.
- E. Make the following documents available to auditors at a minimum:
 - 1. Daily time sheets and supervisor's daily reports.
 - 2. Union agreements, if any.
 - 3. Insurance, welfare, and benefits records.
 - 4. Payroll registers.
 - 5. Earnings records.
 - 6. Payroll tax forms.
 - 7. Material invoices, purchase orders, requisitions, and all material and supply acquisition contracts.
 - 8. Material cost distribution work sheet.
 - 9. Equipment records including internal rates charged to the project.
 - 10. Vendor rental agreements and subcontractor invoices.
 - 11. Subcontractor payment certificates.
 - 12. Canceled checks (payroll and vendors).
 - 13. Job cost report.
 - 14. Job payroll ledger.
 - 15. General ledger, general journal if used, and all subsidiary ledgers and journals together with all supporting documentation pertaining to entries made in these ledgers and journals.
 - 16. Cash disbursements journal.
 - 17. Depreciation records on all company equipment used in performance of the work.
 - 18. All other documents used to develop costs for internal purposes to establish the actual cost of owning and operating equipment used in performance of the work.
 - 19. All documents related to preparing bid, including final documents on which the bid was based - Exclude documents placed in escrow.
 - 20. All documents that relate to each and every claim together with all documents that support the amount of damages as to each claim.
 - 21. Worksheets used to prepare the claim establishing the cost components for items of the claim including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, all documents that establish the time periods, individuals involved, and the hours and rates for the individuals.
 - 22. Any other documents that the Department deems necessary to assess the validity of a claim.

- F. Full compliance with the provisions of this article is a contractual condition precedent to the right to seek judicial relief.

1.20 CLAIMS HIGHER LEVEL REVIEW

- A. Make a good-faith effort to settle the claim by utilizing the Partnering Escalation Ladder identified in the Partnering Field Guide prior to submitting a claim and requesting a meeting with the Claims Review Board.
- B. Submit a written request for a higher-level review to the Engineer within 10 calendar days after receiving the Engineer's decision or offer if not accepting the Engineer's denial of a claim, or a settlement offer.
 - 1. Attach to the written request for a higher-level review all required information.
- C. Failure to submit a request within this 10-day time frame is considered acceptance of the Engineer's claim denial or offer.

1.21 CLAIMS REVIEW BOARD

- A. A Claim will be referred to the Claims Review Board (CRB) when requested, as provided in this article.
- B. The purpose of the CRB is to provide an independent and impartial review of submitted claims, written findings, and recommendations to the Department's Deputy Director.
- C. Scheduling a hearing or utilizing the CRB does not relieve the Contractor or Department of complying with all Contract terms and conditions, and does not waive any notice or timeliness requirements.
 - 1. Proceed diligently with all work during the CRB process.
- D. The Director of Construction or designee schedules a hearing before the CRB when deemed to be in the best interest of both the Contractor and the Department based on the request for a higher-level review.
 - 1. The claim may be presented informally with or without legal counsel.
 - 2. Notify the Department at least 10 calendar days before the meeting when using legal counsel.
 - 3. Legal counsel will be allowed to attend the presentation, and will be allowed to make brief opening and closing remarks and advise their clients.
 - a. No other participation by legal counsel at the presentation will be permitted.

- E. Parties will bear their own costs.
 - 1. All costs associated with preparation and participation in the CRB meeting will be the responsibility of each party.
 - 2. No compensation for travel, time, research activities, time away from the project, presentation preparation, presentation time, or any other activities associated with the preparation for or participation in the CRB process will be given to either party.
- F. Pre-presentation Requirements
 - 1. The Department and the Contractor will prepare concise written statements describing the claim and each party's position with reasoning and submit to the Department's Project Controls Engineer who will distribute them to the other party a minimum of ten calendar days before the scheduled presentation.
 - 2. The parties will submit their visual presentation to the Project Controls Engineer who will distribute it to the other party a minimum of ten calendar days before the scheduled presentation, if either party chooses to prepare a visual presentation.
- G. Presentation
 - 1. The party that is in attendance will prevail in their position on the claim if either the Department or the Contractor fails to appear before the CRB on the date and time scheduled for the presentation without justifiable cause.
 - 2. The Contractor will present their position first, followed by the Department.
 - 3. The duration of each party's presentation will be determined when the Claim meeting is scheduled and will be agreed to by both parties.
 - a. The duration may vary depending on the complexity and size of the claim.
 - 4. Only information or claims related to the original claim may be discussed in the hearing.
 - a. No new information may be submitted.
 - b. The CRB will inform the party that no additional information or claims are permitted if the Contractor or Department attempts to submit new information.
 - 5. Recording the meeting by any means is prohibited.
 - 6. This presentation is informal, allowing for the Contractor and Department to present their positions, and for all parties to exchange questions and answers.
 - 7. The meeting will be conducted as follows:
 - a. The chairman informs the meeting attendees of the procedures and format of the meeting.
 - b. Both parties may deliver brief opening and closing remarks.

- c. The Contractor presents their claim in detail as supported by previously submitted information and documentation.
 - 1) The presentation can be verbal or visual.
 - d. The Department presents its detailed position as supported by previously submitted information and documentation.
 - 1) The presentation can be verbal or visual.
 - 8. The CRB may allow rebuttals by both parties during the meeting after both the Contractor and Department make their presentations.
 - a. Rebuttals will not be heard after the meeting has ended.
- H. Offer of Settlement or Rejection of Claim
 - 1. The Department Deputy Director makes an offer of settlement within 45 calendar days of the claim hearing if the offer is less than the amount required to be reviewed by the Transportation Commission.
 - 2. The decision of the Department Deputy Director is administratively final.
 - a. The CRB hearing ends all administrative appeal processes available.
 - b. The Contractor may elect to file a complaint in State court if the claim is rejected, or if the sum tendered by way of settlement is not acceptable to the Contractor.
- I. Acceptance or Rejection
 - 1. Provide written notice to the Department Deputy Director of acceptance or rejection of the offer or rejection of the claim within ten days of the date of the Department Deputy Director's offer.
 - a. The Department will promptly process any required payments or contract changes if both the Department and Contractor agree to resolve the Claim.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 00820

LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

PART 1 GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress
- B. Section 01355: Environmental Compliance
- C. Section 01554: Traffic Control

1.3 REFERENCES

- A. Code of Federal Regulations (CFR)
- B. UDOT Safety and Health Manual
- C. UDOT Owner Controlled Insurance Program (OCIP)
- D. United States Code (USC)
- E. Utah Code
- F. Utah Occupational Safety and Health (UOSH)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 OBSERVING LAWS, RULES, AND REGULATIONS

- A. Observe and comply with all of the following that affect the conduct of work on the project, have jurisdiction or authority over the work, or that affect individuals engaged or employed on the project:
 - 1. Federal, State, and Tribal regulations and administrative rules.
 - 2. Orders and decrees of bodies, tribunals or health officials having any jurisdiction or authority over the Contractor, subcontractors, employees and agents.
 - 3. UDOT Safety and Health Manual

- B. Indemnify, defend, and save harmless the State, the Department, and representatives against claim or liability arising out of or caused from violations of any of the above listed items resulting from any negligent or wrongful act, error or omission, or other liability imposed by law, whether violated by employees, agents, or contractors of the following:
 - 1. Contractor
 - 2. Subcontractors at any tier
 - 3. Suppliers of materials or services
 - 4. Design professionals engaged by the Contractor and persons under their control
 - 5. Any others contracted by the Contractor or subcontractors
- C. Do not require employees of the Contractor or subcontractor to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to health or safety.
 - 1. Immediately correct any conditions that do not comply with the foregoing provisions.
 - a. The Engineer issues a stop work order when either site conditions or work practices present an imminent danger that may result in serious injury, death, or extensive property damage until those conditions or practices are corrected.
 - b. A stop work order does not provide relief from completing the project within the specified contract completion time.
- D. Allow access to all areas of work on the project and admit any inspector of the UOSH or other legally responsible agency involved in safety and health administration without delay and without presentation of an inspection warrant to all areas of the work and project site upon presentation of proper credentials.
- E. Comply with Federal, State and local laws, rules, and regulations that enumerate unlawful employment practices including:
 - 1. Discrimination because of race, religion, color, sex, age, disability, or national origin and that define actions required for Affirmative Action and Minority/Disadvantaged Business programs.
 - 2. Employment and verification of employment eligibility of all people employed by any Contractor or subcontractor performing work. Compliance must be according to provisions of USC Section 1324A and Utah Code Section 63G-12-302.
- F. Immediately notify the Engineer upon discovering any discrepancy or inconsistency between the contract and any law, ordinance, regulation, or order except as noted in this Section, Article 1.8.

- G. Immediately notify the Engineer of any deviation from the contract provisions pertaining to environmental compliance, including but not limited to things such as spills, unauthorized fill in waters of the State including wetlands, water quality standards, noise, or air quality.
- H. Coordinate with and receive approval from the Utah Department of Technology Services (DTS) Information Technology (IT) Director assigned to the Department before beginning any IT related activities as defined in Utah Code, Section 63F-1-102.
 - 1. Do not engage in software development without such prior approval.
- I. Comply with CFR, UOSH –or UDOT Safety and Health Manual, whichever is the most restrictive in the use, handling, loading, transportation, and storage of explosives and blasting agents.
 - 1. Do not endanger life, property, or work with the use of explosives.
 - 2. Accept liability for property damage, injury, or death resulting from the use of explosives.
 - 3. Notify property owners and public utility companies in the vicinity of the proposed detonation before using any explosives.

1.7 PROTECTING FORESTS

- A. Perform work within or adjacent to State or National Forest under regulations of the State Fire Marshal, Conservation Commission, Forestry Department, or other authority having jurisdiction governing the protection of forests.
- B. Prevent and assist with the suppression of forest fires.
- C. Cooperate with responsible forestry officials.

1.8 PERMITS, LICENSES, AND TAXES

- A. Acquire all permits and licenses; pay applicable charges, fees, and taxes; and give all notices necessary to perform the work.

1.9 PATENTED DEVICES, MATERIALS, AND PROCESSES

- A. Provide proof of legal agreement with the patentee or owner, if necessary, for use of a design, device, material, or process covered by letters, patents, or copyrights.

- B. Indemnify, defend, and save harmless the Department and any affected third party or political subdivision of the State from claims of infringement of patents, copyrights, or trademarks.
- C. Indemnify the Department for costs, expenses, and damages, that it may be obligated to pay as a result of an infringement during the work or after the project is completed.

1.10 FEDERAL AID PARTICIPATION

- A. Federal requirements of a federally assisted contract supersede conflicting provisions of lower tiered laws, rules, or regulations (for example, State).
- B. Federal officials may inspect the work when there is Federal participation in the contract. The U.S. Government is not a party to the contract and will not interfere with the rights of contract parties.

1.11 PUBLIC CONVENIENCE AND SAFETY

- A. Perform work with minimal obstruction to traffic.
- B. Follow the safety provisions of all applicable laws, rules, codes, and regulations to protect the safety and convenience of the public and property.
- C. Provide, erect, and maintain all traffic control devices such as barriers, barricades, and warning signs according to the TC Series Standard Drawings and Section 01554 requirements to protect the work and the public safety.
 - 1. Use barriers and barricades to delineate highway sections closed to traffic.
 - 2. Illuminate obstructions during darkness and provide warning signs to control and direct traffic.
- D. Erect warning signs for work that may interfere with traffic, or where new work crosses or coincides with an existing road.
 - 1. Place and maintain warning signs according to the authorized Traffic Control Plan.
 - 2. Obtain approval before dismantling or removing traffic control devices.
- E. Pedestrians
 - 1. Place and maintain warning signs according to the authorized Traffic Control Plan.
 - 2. Provide ADA compliant access in areas where construction interferes with existing access.

1.12 PROTECTING AND RESTORING PROPERTY AND LANDSCAPE

- A. Preserve public and private property during the work.
- B. Secure legal right to access the property before any work is performed on public or private property. All damage as a result of trespass will be the financial responsibility of the Contractor including additional acquisition costs.
- C. Accept liability for any damage to public or private property resulting from defective work, materials, or non-execution of the contract until contract completion.
- D. Restore damaged property and items removed temporarily during construction to a condition similar or equal to that existing before the damage.
- E. Temporarily discontinue work if remains of prehistoric dwelling sites or artifacts of historical or archeological significance are encountered. Refer to Section 01355.

1.13 THIRD-PARTY BENEFICIARY CLAUSE

- A. Department contracts do not authorize anyone who is not a party to the contract the right to maintain an action for damages under the contract's provisions or to any of the rights of a third-party beneficiary.
- B. Department contracts do not prohibit the parties from agreeing to provide third-party beneficiary rights to another party so long as those rights are set forth in a separate agreement and signed by all the parties to this contract and the intended third-party beneficiary.

1.14 DEPARTMENT EMPLOYEES PERSONAL LIABILITY

- A. The Department's authorized representatives act solely as agents and representatives of the Department when carrying out the provisions of or exercising the power or authority granted to them under the contract.
- B. The Department's authorized representatives are not liable either personally or as employees of the Department for actions in their ordinary course of employment.

1.15 NO WAIVER OF LEGAL RIGHTS UPON COMPLETION

- A. The Department makes final inspection and notifies the Contractor of acceptance upon completion of the work.
 - 1. Acceptance does not prevent the Department from correcting any measurement, estimate, or certificate made before or after completion of the work.
 - 2. The Department is not prevented from recovering from the Contractor or Surety or both, overpayment sustained for failure of the Contractor to fulfill the obligations under the contract.
 - 3. A waiver from the Department for any breach of any part of the contract is not held as a waiver of any other or subsequent breach.
- B. Assume liability to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud or as regards to the Department's rights under any warranty or guaranty without prejudice to the terms of the contract even after completion.

1.16 RESPONSIBILITY FOR DAMAGE CLAIMS

- A. Protect, indemnify, defend and save harmless the State of Utah, the Department, and their officers, agents, and employees from and against all claims, demands, damages, and causes of action of every kind or character on account of bodily injuries, death, or damage to property arising out of, resulting from, or in any way connected with the performance of the contract to the extent allowed by law.
- B. Defend the Department against all third party or other lawsuits arising out of or resulting from the contract work.
 - 1. The Department may require that the Contractor represent the interests of the Department or may choose to have separate counsel.
 - 2. The Department pays for its own attorneys' fees, costs, and expenses if it employs its own counsel.
 - 3. Total defense costs will be apportioned accordingly upon determination by the court of the proportionate liability for the claim.
 - a. The Department pays 60 percent of the total defense costs while the Contractor pays 40 percent, if the court finds the Department to be 60 percent liable for the claim and the Contractor 40 percent liable, for example.

- C. The Contractor and the Department will agree to provide each other with a copy of the summons and complaint within a reasonable time if served with a lawsuit or Notice of Claim.
 - 1. Contractors may not file a responsive pleading on behalf of the Department until receiving written notice that the Department chooses to have the Contractor handle the defense.
 - 2. The Department will provide the Contractor such written notice in a timely manner allowing the Contractor adequate time to respond to the summons.
- D. All parties agree to cooperate to the fullest extent possible subject to privileges and ethical rules if the parties have separate counsel.
- E. Provide insurance as defined in this Section from reliable insurance companies authorized to do business in Utah, rated "A" or better and with a financial size category of Class VII or larger by A.M. Best Company, at the time of contract execution.
- F. Notify claimants of their right to appeal to Department's Risk Management Division of denied or partially denied claims of \$5,000 or less by the:
Department's Risk Management Division
4501 South 2700 West
P.O. Box 148112
Salt Lake City, UT 84114-8430
Phone: (801) 965-4116
 - 1. Provide the following information to the claimant:
 - a) A time deadline for requesting re-examination equal to seven days after notification of denial or partial denial.
 - b) Address and name to whom it should be directed (Risk Management Division).
 - c) Department project number and location.
 - 2. The Contractor's denial of the claim can be overturned by the Department if claimant is not notified of right to request re-examination.
 - a) The Risk Management Division can waive the time deadline.
 - b) The Risk Management Division cannot review any claim filed in the small claims court, district court, or appealed to the district court.
- G. Cooperate with the Department's Risk Management Division in resolving disputes regarding denials or partial denials from an insurance carrier.
 - 1. The Risk Management Division will hold in-person hearings and rely on documentation prepared by the Contractor, the insurance carrier, the claimant, and the Department.

2. Neither the insurance carrier nor the Contractor has the right to intervene in a re-examination before the Risk Management Division.
 3. The Risk Management Division decides the claim as expeditiously as possible.
 4. The decision by the Risk Management Division is administratively final.
- H. The Department may deduct from the Contractor's pay estimate, claims that the Contractor's liability insurance carrier denied but are directed to be paid by the Department's Risk Management Division.

1.17 INSURANCE REQUIREMENTS

- A. Use Insurance Program #1 for projects where OCIP is not required. Use Insurance Program #2 for projects where OCIP is required. Include cost for the applicable insurance program in the bid prices.
- B. Insurance Program #1
Provide insurance according to the following:
1. Workers' Compensation Insurance
 - a. Provide Workers' Compensation Insurance to cover full liability. Comply with the statutory limits defined by the State of Utah as a minimum.
 2. General Liability Insurance
 - a. Provide General Liability insurance with the following minimum limits of liability:
 - 1) \$1 million Bodily Injury and Property Damage – Each Accident
 - 2) \$3 million General Aggregate
 - 3) \$3 million Products and Complete Operations Annual Aggregate
 3. Automobile Liability Insurance
 - a. Provide Automobile Liability Insurance for claims arising from the ownership, maintenance, or use of motor vehicles involved in project work with the following minimum limits:
 - 1) \$1 million combined single limit bodily injury and property damage per occurrence.
 4. Provide the following for all required liability insurance policies:
 - a. Name the State of Utah and all institutions, agencies, departments, authorities, and instrumentalities, and while acting within the scope of their duties, all volunteers as well as members of governing bodies, boards, commissions, and advisory committees as Additional Insured where and when applicable in respect to work to be performed under this contract.

- b. Incorporate into the insurance policy this statement:
“Insurance coverage is extended to include claims reported up to one year beyond the date of substantial completion of this contract.”
 - 5. Provide the Department with certificates of insurance showing that they are covered as required by Insurance Program #1, before entering the project site or beginning project work. The certificates will also state that the policies required are endorsed to give the Engineer not less than 30 days notice before cancellation or change in coverage. The Department may object within five days of receiving written notice that the Contractor intends to cancel its insurance or change coverage to the extent that it does not comply with the contract requirements. The Department may cancel this contract immediately or sue for an injunction or any other legal remedy to require Contractor to keep its current coverage if Contractor cancels coverage or changes coverage despite that objection.
 - 6. Regardless of the Contractor insurance requirements required in this section, insolvency, bankruptcy, or failure of any insurance company to pay all claims accrued does not relieve Contractor of any obligations.
 - 7. Endorse all policies to include waivers of subrogation in favor of the Department.
 - 8. The Engineer gives the Contractor written notice that the certificates need to be modified within 10 calendar days so as to give the Department the required endorsements if the Department discovers that the Contractor’s policies are not endorsed to the Department.
 - a. Provide new certificates to the Engineer at that time.
 - b. The Department may terminate the Contract for Default as specified in Section 00555 if certificates are not obtained.
- C. Insurance Program #2
The Contractor must participate in the Department Owner Controlled Insurance Program (OCIP).
- 1. Refer to <http://www.udot.utah.gov/go/standardsreferences> for OCIP General Conditions for coverage limits and conditions.

1.19 AIR QUALITY PROTECTION

- A. Refer to Section 01355.

- B. Contact the Utah Division of Air Quality (DAQ) and obtain the appropriate Air Quality Permit for the project. Permit application forms can be obtained from DAQ's Web site. Refer to <http://www.udot.utah.gov/go/standardsreferences>.

Utah Division of Air Quality
195 North 1950 West
PO Box 144820
Salt Lake City, UT 84116
Phone: (801) 536-4000
Fax: (801) 536-4099

- C. Do not proceed with work affecting air quality without an Air Quality Approval Order, Notice of Intent to Approve letter, or a Temporary Approval Order for the project, process, or equipment to be used.

1.20 GRATUITIES

- A. Do not extend any loan, gratuity, or gift of money in any form whatsoever to any employee or officer of the Department; nor rent or purchase any equipment or materials from any employee or officer of the Department. Before payment of the final estimate will be made, execute and furnish the Department an affidavit certifying compliance with these provisions of the Contract.
- B. Comply with all applicable sections of the Utah Public Officers' and Employees' Ethics Act, Utah Code Procurement Code, Utah Code §§ 63G-6a-101 et seq., both of which regulate gifts to State officers and employees.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01280
MEASUREMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Measuring and calculating pay item quantities.

1.2 RELATED SECTIONS

- A. Section 00777: Change Management
- B. Section 01721: Survey

1.3 REFERENCES

- A. Utah Code
- B. U.S. Bureau of Standards

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 QUANTITY MEASUREMENT

- A. General
 - 1. The Department uses nominal weights and dimension, and industry-manufacturing tolerances unless otherwise specified
 - 2. The Department measures and determines quantities of material furnished and work performed according to the measurement and payment section of the contract.
 - 3. The Department identifies standard manufactured items by gauge, unit, weight, or section dimensions.
- B. Plan Quantity
 - 1. The calculated quantity in the Bidding Schedule is the quantity for which payment will be made.

2. An adjustment to the final quantity for payment may be made if an error is discovered in the calculated quantity by either the Department or the Contractor. Refer to Section 00777.
 - a. Provide all computations, plots, and supporting documentation necessary for the Engineer to verify the error and determine the final quantity for payment.
 - 1) Work required to provide computations, plots, and supporting documentation may be paid for as new work when the final quantity differs from the calculated quantity by more than 10 percent.
 - b. The Engineer may adjust the final quantity for payment by the amount of increase or decrease to the calculated quantity in the Bidding Schedule based on provided supporting documentation.
- C. Lump Sum or Each
 1. The Department measures the complete structure or structural unit, signal or lighting system, or other items of work specified in the Bidding Schedule to be measured by lump sum or each to include all necessary work, fittings, and accessories for a complete unit or system.
 2. "Lump sum" or "each" includes all resources necessary to complete the work.
- D. Length
 1. Items measured by length are measured parallel with the base or foundations upon which the items are placed.
 2. The term "station" is 100 linear feet when used as a definition or term of measurement.
- E. Area
 1. The Department uses horizontal longitudinal and plan (neat) transverse measurements unless otherwise specified.
- F. Volume
 1. The Department measures items using plan (neat) dimensions, or altered dimensions when approved by the Engineer to fit field conditions.
 2. The Department uses average end area or computer generated Digital Terrain Model (DTM) method for computing volumes.
 3. Materials specified to be measured by volume may be converted to unit weight for payment purposes when approved.
 - a. Obtain approval for all factors for conversion from volume to weight before using this method of measurement.

- G. Weight
 - 1. The term “ton” means 2,000 pounds avoirdupois.
 - 2. Measure aggregate weight in the saturated surface dry condition.
- H. Alternative methods of measurement
 - 1. Refer to Section 01721.

1.7 WEIGHING REQUIREMENTS AND PROCEDURES

- A. Weigh all materials that are measured or proportioned by weight, or contract items measured by the ton, such as aggregates and asphalt materials, on scales that have been approved, certified, and that meet specification requirements.
 - 1. Obtain certified haul truck tares at times as determined by the Engineer and place a legible identification mark on each truck.
 - 2. The Department may return to be reweighed any loads that appear to be deficient or questionable.
- B. Furnish, erect, certify, and maintain, or use permanently installed and certified commercial scales for weighing highway and bridge construction materials that are required to be proportioned or measured and paid for by weight.
 - 1. Scales must be accurate within the limits set by the laws of the State of Utah and meet requirements of the U.S. Bureau of Standards.
 - 2. Scales must bear a current seal of acceptance from the State of Utah Department of Agriculture, Division of Weights and Measures.
 - 3. Have the Utah State Department of Agriculture Division of Weights and Measures inspect and seal all scales at least once a year and after each setup before use, or as requested by the Engineer.
 - 4. Install and maintain platform scales with rigid bulkheads at each end. The platform must be level.
 - a. Platform scales must be of adequate size and capacity so the entire power unit and hauling unit can be weighed at the same time.
 - 5. Physically arrange electronic, beam, dials, platform, and other scale equipment for convenient and safe viewing by the operator and inspector.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

Measurement
01280 – Page 3 of 3

SECTION 01282

PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Scope of Payment
- B. Eliminated Items
- C. Payment
- D. Retainage
- E. Use of Onsite Materials
- F. Fuel Cost Adjustment

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Consent of surety before processing semi-final or final estimate for information. Refer to this Section, Articles 1.8 and 1.15.
- B. Prompt payment certifications. Refer to this Section, Article 1.9.
- C. Payment for material on hand documentation. Refer to this Section, Article 1.13.
- D. Additional payments due statement. Refer to this Section, Article 1.15, paragraph B.

1.6 SCOPE OF PAYMENT

- A. Payment is full compensation for work described for each pay item according to the description, unit of measure, and price in the Bid Schedule.
 - 1. Payment for a pay item includes payment for work specified in the Section defining the work for that pay item including the work in referenced Sections.
 - 2. The cost of work required by the general specifications (Sections 00100 to 01499) is paid for in the appropriate pay items.
 - 3. Work paid for under one pay item is not paid for under another pay item.
- B. The Department will not pay the Contractor for:
 - 1. Work that is in excess of that contained in the contract.
 - 2. Removal and replacement of defective or nonconforming work.
 - 3. Loss of anticipated profits.
 - 4. Remedy of damage caused by the Contractor.
- C. Payment does not relieve the Contractor of the obligation to correct defective or nonconforming work.

1.7 ELIMINATED ITEMS

- A. The Engineer may eliminate pay items found to be unnecessary to complete the work.
- B. Request reimbursement for costs incurred before notification of elimination.

1.8 PROGRESS PAYMENTS

- A. The Department makes progress payments at least once each month as the work is progressing.
 - 1. More frequent progress payments may be made when the value of work performed is greater than \$1,000.
- B. Payments are based on estimates prepared by the Engineer of the value of work performed and materials in place under the contract and for payment for material on hand according to this Section, Article 1.13.
 - 1. Payment will not be made for material and work without complete acceptance documentation.

- C. The Department deducts and retains five percent from the total value of work until after the entire contract has been completed in an acceptable manner with the following exceptions:
 - 1. The Engineer may prepare a semi-final estimate with the consent of the surety from which the Department retains 1.5 percent of the original contract amount when no less than 95 percent of the work has been completed.
 - 2. The Department certifies the remainder for payment, less previous payments.
- D. The Contractor may enter into an addendum agreement providing for payment of retained money into an escrow account or the Department does so automatically.
 - 1. This money is applied to the purchase of approved securities that are to be held by an escrow agent until satisfactory completion of the construction contract.
 - 2. The value of the securities placed in escrow has a minimum value equal to or greater than the amount that would otherwise be retained.
 - 3. The addendum agreement must be executed concurrently with the execution of the construction contract. Agreement forms are available in the office of the Department's Director for Construction.
- E. The Department pays the Contractor within 14 calendar days after certification and approval of billings and estimates.
 - 1. Contractor and Engineer agree to a Saturday partial estimate closing date. Succeeding partial estimates close on the same Saturday for each succeeding month.
 - 2. Contractor approves partial estimate before submission.

1.9 PROMPT PAYMENT

- A. Pay subcontractors and contracts in any form such as leases, task orders, and suppliers for satisfactory performance of contracted work no later than 30 calendar days after receiving payment from the Department. Include prompt payment provision in each contract stating that each subcontractor agrees to pay lower tier subcontractors and contracts in any form such as leases, task orders, and suppliers within 30 days from receipt of each payment.
- B. The entry date is tied to the date the pay estimate is processed by the Department's comptroller.
 - 1. Enter the dates that payments are sent to the subcontractor into the Department's Information Technology (IT) system within 30 calendar days of receiving payment from the Department.

2. The Department considers the entry of payment dates into the Department's system as an affidavit certifying prompt payment by the prime Contractor.

1.10 PAYMENT DELAY

- A. Delay payment only for cause and document the reason in the comments area of the Department's IT system. This will serve as notification to the Department.
 1. Send notification to the subcontractor.
 2. The Contractor is considered non-compliant if no payment is made to the subcontractor and there are no comments in Department's IT system explaining why the subcontractor's payment is being withheld for cause.
 - a. Contractor is subject to the provisions in this Section, Article 1.11.
 3. The Department may withhold the dollar amount of delayed payment, including retention, from future estimates.
- B. Provide subcontractor 15 calendar days from the date of written notification to correct deficiencies.
 1. Release payment upon receipt of documentation demonstrating correction of deficiencies within 15 calendar days.
- C. Include language in the subcontract that provides for the use of appropriate alternative dispute resolution mechanisms to resolve payment disputes.
 1. The Department may hold disputed funds until the dispute is resolved.
 2. The Department may issue a partial payment to resolve the issue.

1.11 FAILURE TO MAKE PROMPT PAYMENT

- A. The Engineer will notify the Contractor upon determination of failure to make prompt payment.
 1. Make prompt payment within three working days of receiving notification.
- B. The Department considers failure to make prompt payment a contract violation for which the Contractor is subject to one or more of the following measures:
 1. Forfeit the privilege of bidding on Department projects until payment covered by this Section is made.
 2. Forfeit the privilege of having a subcontract to perform work or supply materials on Department projects until payment is made according to this Section.

- C. The Department may consider additional measures up to and including debarment for repeated failure to make prompt payment.
 - 1. Failure to pay subcontractors promptly may affect Contractor's rating.
- D. The Department may employ other mechanisms consistent with this Section and applicable state and local law so payment is fully and promptly made.

1.12 RETAINED MONEY

- A. Include in the subcontract language a clause agreeing to pay retainage owed to the subcontractor for satisfactory completion of the accepted work within 30 calendar days after receiving payment from the Department.
- B. Retention for subcontracted work is paid upon satisfactory completion and acceptance by the Department.
 - 1. Pay subcontractor within 30 calendar days after receiving retention payment from the Department.
- C. Require notification from the subcontractor when subcontracted work is complete.
 - 1. Notify the Engineer within two working days after notification from the subcontractor.
 - 2. The Department releases an amount equal to the subcontractor's retention upon acceptance of the work.

1.13 PAYMENT FOR MATERIAL ON HAND (STOCKPILE)

- A. The Department may include advance partial payments for acceptable nonperishable materials purchased expressly for incorporation in the work when delivered in the vicinity of the project or stored in approved storage place.
 - 1. Present the delivery copies of invoices.
 - 2. The Engineer determines the amount to be included in the estimate but in no case will the amount exceed the value of the materials as shown on the delivery invoice or 75 percent of the in-place price, whichever is less.
 - 3. Furnish evidence that the stockpiled materials are irrevocably obligated to the project when the approved storage location is other than the project site.
 - 4. The Department does not pay when the invoice value of such materials, as determined by the Engineer, amounts to less than \$2,000 or if materials are to be stored less than 30 calendar days, unless otherwise specified.

- a. The Department will waive the 30 day limit and pay advance payment for Pavement Marking Tape if the Pavement Marking Tape placement is delayed more than one week beyond the original CPM schedule date.
- 5. Furnish certified paid invoices or a certified statement with a copy of the check showing payment within 60 calendar days following the date of the estimate invoice on which the stockpile material is to be paid by the Department.
- 6. Material will be removed from the next partial estimate as stockpiled materials if proper invoices showing payment to the supplier is not received.
- B. The Department does not make partial payment on living or perishable materials until incorporated as described.
- C. The Department does not pay for materials brought onto the site at the Contractor's election that may be incorporated into the project such as fuels, supplies, metal decking forms, ties, or supplies used to improve efficiency of operations.
- D. Approval of partial payment for stockpiled materials does not constitute acceptance of such materials for use in completing items of work.
- E. The Department may purchase unused materials at actual cost for materials delivered to the project in compliance with the contract or left unused due to changes in plans or variation in quantities, if the materials are not practicably returnable for credit.
 - 1. Purchased materials become the property of the Department.
 - 2. Actual costs are based on invoice price plus transportation costs.
 - a. The Engineer may allow a maximum of 10 percent markup.
- F. Payment is limited to contract quantities unless ordered by the Engineer. Assume responsibility for excess materials delivered to the project or aggregate produced beyond the contract amount without authority from the Engineer.
- G. Surplus aggregates up to the contract quantities may be purchased at the option of the Department, provided the material is stockpiled where directed and meets specification requirements when stockpiled.
 - 1. The Department pays for material accepted on an agreed price basis which is normally the Contractor's production cost.
 - 2. The Department pays a negotiated price for transporting and stockpiling materials at the directed location.

1.14 USE OF ON-SITE MATERIALS

- A. Obtain approval before using excavated materials found on the work site that are suitable for completing other pay items of work.
 - 1. The Department pays for the quantity of excavated materials at the contract unit price for roadway excavation and under the pay item for which the material is used.
 - 2. The Department does not charge for the materials used except that the Contractor must replace excavated material with acceptable material at no cost to the Department.
 - 3. Obtain approval before excavating material outside grading limits.
- B. Salvageable material is the property of the Contractor unless otherwise described.

1.15 FINAL PAYMENT

- A. The Engineer prepares the final estimate of work performed when the project has been accepted as specified in Section 00555.
 - 1. The Department processes the estimate for final payment if the Contractor approves the final estimate and does not object to the quantities within 30 calendar days of receiving the final estimate.
 - 2. The Department pays the entire sum due after deducting previous payments and amounts to be retained or deducted under the provisions of the contract after approval of the final estimate by the Contractor.
 - 3. The consent of the surety is required for the final estimate when a semi-final estimate is not processed.
 - 4. At the discretion of the Engineer, an affidavit may be required from subcontractors certifying they have been paid for labor, materials and equipment incorporated into the project.
- B. Submit a full, complete, and itemized written statement justifying a pay adjustment within 30 calendar days after the final estimate is submitted for approval if additional payment is believed due from the Department.
 - 1. Contractor waives disputes not itemized.
 - 2. Submission of disputes by the Contractor will not be reason for withholding full payment of the total value of work shown on the Engineer's final estimate.
 - 3. The Department evaluates the dispute.
 - a. The final estimate is revised accordingly under the terms of the contract if it is determined that additional payment is due.
 - b. The estimate as submitted is final if it is determined that no additional payment is due.

- C. Prior partial estimates and payments are subject to correction in the final estimate and payment.
- D. The Department completes and delivers the final estimate to the Contractor within 90 days of contract completion.

1.16 FUEL COST ADJUSTMENT

- A. Fuel cost adjustment is intended to limit the risk to the Contractor from potentially unstable fuel prices that might occur during the contract.
 - 1. This provision is not intended to estimate actual quantities of fuel used in construction operations or compensate for actual price variations experienced by the Contractor.
 - 2. The Department determines adjustments under the provisions of this Section and presumes the Contractor has relied on these provisions when determining unit bid prices.
 - 3. The Contractor may invoke this provision within the contract time by notification to the Engineer.
 - a. Adjustments are made on prior and future partial estimates.
 - b. This provision becomes effective when invoked by the Contractor and remains in effect for the duration of the contract.
- B. Abbreviations and Terms
 - 1. Estimate Price for fuel (EPf) – The fuel price established for the partial estimate period.
 - a. The Department determines the EPf on the first Monday of each month using the spot price per barrel for West Texas Intermediate (WTI) crude oil. Refer to <http://www.udot.utah.gov/go/standardsreferences>. This spot price is averaged with spot prices posted for the previous three Mondays to establish the EPf.
 - b. The EPf remains in effect until the first Monday of the following month and is used for regular partial estimates closed before the first Monday of the following month.
 - 2. Base Price for fuel (BPf) – The contract base fuel price, equal to the EPf in effect on the date of the contract bid opening.
 - 3. Fuel Factor (FF) – A combined diesel and gasoline usage factor established for purposes of calculating the Fuel Cost Adjustment.
 - a. Table 1 shows the items of work eligible for adjustment.
 - 4. Fuel Cost Adjustment (FCA) – The fuel cost adjustment in dollars determined according to this article.

C. Determining FCA

1. FCA applies only to acceptable work performed on individual contract items in Table 1 with values of more than \$100,000 based on original contract quantities, unless otherwise specified in Table 1
2. FCA does not apply to work added by change order.
3. FCA may be positive or negative depending on the changes or differences between the BPf and the EPf.
4. Work performed after the expiration of contract time, the EPf will be limited to the lesser of:
 - a. The EPf for the estimate period when the work was performed.
 - b. The EPf for the last partial estimate period before the expiration of the contract time.

D. FCA Formula

When the EPf is more than 15 percent above the BPf

$$FCA = \frac{[(EPf - BPf) - 0.05 BPf] Q (FF)}{42}$$

When the EPf is more than 15 percent below the BPf

$$FCA = \frac{[(EPf - BPf) + 0.05 BPf] Q (FF)}{42}$$

Where:

Q	=	Quantity of acceptable work performed
FF	=	Fuel factor for Q
42	=	Conversion of gallons of fuel per barrel of crude

- E. The Department determines the feasibility of proceeding with the remainder of the project and notifies the Contractor if the project is to be terminated if the EPf increases by more than 50 percent from the BPf for an eligible item of work.

Table 1

Items Eligible for FCA		
Item of Work	Quantity of Work (Q)	Fuel Factor (FF)
Roadway Excavation, Borrow, Granular	Ton	0.25
Borrow, Top Soil	Cubic Yard	0.45
Underdrain Granular Backfill	Cubic Yard	1.16
Untreated Base Course	Ton	0.84
	Cubic Yard	1.63
Hot Mix Asphalt	Ton	3.60
	Cubic Yard	6.80
Open Graded Surface Course	Ton	3.60
	Cubic Yard	6.80
Stone Matrix Asphalt (SMA)	Ton	3.60
	Cubic Yard	6.80
Other Asphalt Mix Products with Mix Design	Ton	3.60
	Cubic Yard	6.80
Rotomilling	Sq Yd	0.03
Profile Rotomilling	Sq Yd	
In-Place Cold Recycled Asphaltic Base	Sq Yd	
Recycled Surface	Sq Yd	
Chip Seal Coat	Square Yard	0.03
Microsurfacing		
Portland Cement Concrete Pavement	Sq Yd-In	0.214
Lean Concrete Base Course	Sq Yd-In	0.048
Riprap	Cubic Yard	0.57
	Ton	0.25
Bridges exceeding \$500,000 Includes the following items: Structural Concrete, Piles, Reinforcing Steel, Prestressed Concrete Members, and Structural Steel 36 inch and larger pipe culvert – combined items exceeding \$200,000	\$	0.038

1.17 ASPHALT COST ADJUSTMENT

- A. Asphalt cost adjustment is intended to limit the risk to the Contractor from potentially unstable asphalt prices that might occur during the Contract.
1. This provision is not intended to estimate actual quantities of asphalt used or compensate for actual price variations experienced by the Contractor.

2. The Department determines adjustments under the provisions of this article and presumes that the Contractor has relied on these provisions for adjustments when determining unit bid prices.
 3. The Contractor can choose to opt out of the Asphalt Cost Adjustment (ACA).
 - a. Check the appropriate box on the bid proposal indicating the intent to opt out of the ACA.
 - b. The ACA cannot be reactivated on a project for which the Contractor has opted out.
- B. The Department adjusts the price of asphalt materials for acceptable work performed on pay items that contain asphalt materials.
- C. Abbreviations and Terms
1. Estimate Price for asphalt (EPa) – The asphalt price established for the partial estimate period.
 - a. On the first Monday of each month, the Department determines the EPa using price values from the most recent Poten & Partners Asphalt Weekly Monitor and Argus Asphalt Report. The Department averages values for the following, eliminating the single highest and single lowest values, before averaging.
 - 1) The high reported selling price (per ton) of typical non-modified paving grades of asphalt from the Asphalt Weekly Monitor.
 - Arizona
 - Phoenix area
 - Flagstaff area
 - Tucson area
 - Idaho
 - Boise area
 - Eastern markets
 - Northern markets
 - Nevada
 - Las Vegas area
 - Reno area
 - New Mexico
 - Eastern markets
 - Western markets
 - Utah
 - Salt Lake City area

- 2) The high reported wholesale asphalt price (per ton) from the Argus Asphalt Report for Rocky Mountain and West coast asphalt prices for:
 - Denver
 - Las Vegas
 - Montana
 - Phoenix
 - Salt Lake City
 - Utah
 - Wyoming
- b. This average value is then averaged with values obtained in the same manner for the previous three weekly reports to establish the EPa.
- c. The EPa remains in effect until the first Monday of the following month and is used for regular partial estimates closed before the first Monday of the following month.
2. Base Price for asphalt (BP_a) – The contract base asphalt price, equal to the EPa in effect on the date of the contract bid opening or other date where prices are submitted for the establishment of a contract such as the proposal submittal date for a design build project.
3. Adjusted Base Price for asphalt (ABP_a) is 115 percent of the BP_a on the up side and 85 percent of the BP_a on the down side. No price adjustment will be paid when the EPa is between 85 percent and 115 percent of the BP_a.
4. Asphalt cost adjustment (ACA) – The asphalt cost adjustment in dollars determined according to this article.

D. Determining the ACA

1. The provisions of this article become effective and remain in effect for the duration of the contract when the EPa of asphalt materials changes more than 15 percent from the BP_a.
2. The Engineer determines ACA for each partial estimate following this provision becoming effective. The adjustment on each item is determined using the formula in this article.
3. Adjustments in compensation may be either plus or minus depending on the differences between the ABP_a and the EPa.
4. Work added by change order is not eligible for ACA.
5. The EPa will be limited to the lesser of the following for work performed after the expiration of contract time and approved time extensions:
 - a. The EPa for the estimate period when the work was performed.
 - b. The EPa for the last partial estimate period before the expiration of the contract time.

- E. The Department determines the feasibility for proceeding with the remainder of the project if the Partial Estimate Base Price increases by more than 15 percent from the Contract Base Price for an adjustable pay item and notifies the Contractor if the project is to be terminated for cause.

F. Adjustment Formula

When the EPa is more than 115 percent or less than 85 percent of the BP_a

$$ACA = [(EPa - ABPa)] T$$

No price adjustment will be paid when the EPa is between 85 percent and 115 percent of the BP_a.

Where:

T = Quantity in ton of Asphalt Binder Materials used

The Engineer determines T as follows:

1. PG asphalt binders
 - a. The target percentage of new (RAP binder not included) asphalt binder in the approved mix design for the quantity of placed material for:
 - 1) Hot Mix Asphalt (HMA).
 - 2) Stone Matrix Asphalt (SMA).
 - 3) Other mixed material using a mix design target for asphalt binder. Adjust the quantity from target to include only the residual asphalt when the mix design target is an emulsion.
 - b. The quantity of placed asphalt binder for:
 - 1) Open-Graded Surface Course (OGSC).
 - 2) Other mix material where asphalt binder is paid as a separate pay item from the mix.
2. The residual asphalt calculated from the quantity of placed material for Emulsified Asphalts.
3. The quantity of placed material for Cutback Asphalts.

PART 2	PRODUCTS	Not Used

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 01355

ENVIRONMENTAL COMPLIANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Compliance with federal and state environmental regulations.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. American National Standards Institute (ANSI)
- B. Clean Water Act
- C. Code of Federal Regulations (CFR)
- D. Rivers and Harbors Act
- E. U.S. Environmental Protection Agency (EPA) Regulations
- F. Utah Administrative Code (UAC)
- G. Utah Department of Environmental Quality (DEQ) Regulations
- H. Utah Pollutant Discharge Elimination System, Utah Construction General Permit (UCGP)
- I. Utah State Stream Alteration Program

1.4 DEFINITIONS

- A. Fugitive Dust – Small particles originating primarily from soil that are suspended in the air by the wind and by human activities.
- B. Noise Receptor – Property where frequent human use occurs and where a lowered noise level would be of benefit.
- C. Percussive Noise – Short bursts of noise including but not limited to blasting, pile driving, and jack-hammering.

- D. Sound Level – The average sound pressure level from concurrent construction activities related to the project as measured with a sound level meter using the A-weighting network (ANSI S1.4). The standard notation is dB(A) or dBA.

1.5 SUBMITTALS

- A. Stormwater Pollution Prevention Plan (SWPPP) for approval.
- B. Signed copy of the Notice of Intent (NOI) for information.
- C. Signed copy of the Notice of Termination (NOT) for information.
- D. UDOT Environmental Control Supervisor (ECS) Certificate of Training for information.
- E. Fugitive Dust Control Plan for information.
- F. Documentation of environmental clearances for areas not previously cleared for review.

1.6 DISINCENTIVES

- A. Disincentives are assessed against the Contractor in the amount of \$1,000 for each calendar day or portion thereof the project is not in compliance with required permits and regulations.
 - 1. The disincentives assessed increase to \$2,000 per day if the Contractor remains in non-compliance after three days and increase to \$3,000 per day if the Contractor remains in non-compliance after seven days.
- B. Fines issued by regulatory agencies against the Department are added to the disincentives assessed to the Contractor.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 HAZARDOUS WASTE

- A. Suspend work immediately in an area if abnormal conditions are encountered or exposed during construction that indicates the presence of a hazardous waste.
 - 1. Notify the Engineer.

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- B. Do the following if a waste discovered or spilled on site is considered hazardous by meeting the definition for disclosure as defined in Title 40 CFR Part 261, Subpart D – Lists of Hazardous Wastes. Refer to <http://www.udot.utah.gov/go/standardsreferences> for a link to a list of hazardous wastes.
 - 1. Take appropriate actions to minimize the threat to human health and the environment.
 - 2. Contact the Engineer and send notice if waste found on site is determined hazardous.
 - 3. Follow appropriate testing measures to determine if waste is considered hazardous.
 - 4. Notify DEQ, 24-hour Answering Service, (801) 536-4123
 - 5. Follow requirements in UAC R315.
- C. Coordinate with the Engineer to initiate development of a remediation plan according to DEQ and the EPA regulations and requirements.
 - 1. Pay for costs to address hazardous waste discovery or spill cleanup when caused by Contractor's activities.
- D. Complete the work required by the remediation plan before resuming operations in the affected area.

3.2 SPILL OF PETROLEUM-BASED PRODUCT AND USED OIL

- A. Petroleum-Based product
 - 1. Contact the Engineer if a spill occurs adjacent to waterbody or storm drain inlet.
 - a. Send notice following the discovery of the spill.
 - b. Notify DEQ, 24-hour Answering Service, (801) 536-4123.
 - c. Coordinate with the Engineer to remedy petroleum contaminated soils according to UAC R315-8.
- B. Used Oil product
 - 1. Contact the Engineer if a spill occurs that exceeds 25 gallons, or that poses a potential threat to human health or the environment, such as discharging to groundwater, surface water or storm drain inlet.
 - a. Send notice following the discovery of the spill.
 - b. Notify DEQ, 24-hour Answering Service, (801) 536-4123.
 - c. Coordinate with the Engineer to develop a remediation plan for spilled used oil according to UAC R315-15.
- C. Cleanup petroleum-based or used oil product when caused by Contractor's activities.

3.3 WATER RESOURCE PERMITS

- A. Comply with the Utah State Stream Alteration Program.
- B. Comply with Section 10 of the Rivers and Harbors Act.
- C. Comply with Section 404 of the Clean Water Act.
- D. Comply with UCGP requirements for projects with one or more acres of soil disturbances (clearing, grading or excavating).
 - 1. Designate an individual, other than the Superintendent, as the Environmental Control Supervisor (ECS) with the following responsibilities:
 - a. Coordinate with the Engineer regarding UCGP requirements and environmental commitments.
 - b. Manage implementation, modification and record keeping of the project SWPPP.
 - c. Supervise the installation, maintenance and removal of Best Management Practices (BMPs).
 - d. Conduct SWPPP inspections.
 - e. Be available 24 hours a day, seven days a week and can be on-site within a reasonable amount of time from notification as determined by the Engineer.
 - 2. Complete the draft SWPPP for the project.
 - 3. Submit the Notice of Intent (NOI) to the Utah Division of Water Quality (DWQ), after the SWPPP has been signed by the Engineer.
 - 4. Conduct SWPPP inspections at least once a week and within 24 hours following a storm event with a total rainfall amount of ½ inch or greater once earth-disturbing activities have begun.
 - 5. Coordinate with the Engineer to determine if the project has met UCGP requirements before submitting the Notice of Termination (NOT) to DWQ.
- D. Comply with the National Flood Insurance Program for a project within a Special Flood Hazard Area (SFHA), as defined by the Federal Emergency Management Agency (FEMA).

3.4 OPEN BURNING

- A. Do not conduct open burning along highway right-of-way without approval from the Utah Department of Air Quality (DAQ).

3.5 FUGITIVE DUST

- A. Submit a Fugitive Dust Control Plan (FDCG) to DAQ for construction activities as defined in UAC R30, such as:
 - 1. Disturbing a ground surface greater than $\frac{1}{4}$ acre in size.
 - 2. Demolition activities including razing homes, buildings, or other structures.
 - 3. Material storage, hauling, or handling operations.
- B. Minimize fugitive dust from construction activities using methods such as watering and chemical stabilization of potential fugitive dust sources or other methods approved by the DAQ.
 - 1. Do not exceed 10 percent opacity caused by fugitive dust at the project boundary and 20 percent within the project site. This requirement does not apply when wind speeds exceed 25 MPH and the operator is taking appropriate actions to control fugitive dust.
 - 2. Conduct opacity observations according to EPA Method 9 for stationary sources. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 - 3. Use procedures similar to EPA Method 9 to conduct opacity observations for intermittent and mobile sources.
 - a. The requirement for observations to be made at 15 second intervals over a six minute period does not apply.
- C. Minimize fugitive dust from material storage, handling, or hauling operations through the use of covers, stabilization, or other methods approved by the DAQ.

3.6 NOISE CONTROL

- A. Avoid construction activities causing sound levels to exceed 95 dBA in daytime (7:00 a.m. – 9:00 p.m.) or 55 dBA in nighttime (9:00 p.m. – 7:00 a.m.) within 10 ft of the nearest noise receptor.
- B. Schedule work to minimize noise disturbance on Sundays and Holidays in areas with noise receptors.
- C. Percussive Noise
 - 1. Notify the Engineer, the affected noise receptors and the local government authority (if applicable) at least two weeks in advance of percussive noise activity.

3.7 ENVIRONMENTAL CLEARANCE BY THE CONTRACTOR

- A. Obtain authorization before starting any ground disturbing activity not previously cleared by the Department such as wasting project-generated material, excavating borrow material, locating equipment, storage areas, office sites, utility lines, or holding ponds.
 - 1. Cultural and Paleontological – Perform and provide a cultural survey as determined by the Engineer to verify no cultural or paleontological resources are affected by the activity.
 - 2. Threatened or Endangered Species – Perform and provide a wildlife survey as determined by the Engineer to verify no threatened or endangered or other sensitive species are affected by the activity.
 - 3. Federal or State regulated waters – Provide documentation as determined by the Engineer to verify no WoUS and State of Utah waters are impacted by the activity.
 - 4. FEMA Floodplains – Provide documentation as determined by the Engineer to verify no FEMA Special Flood Hazard Areas (SFHA) are impacted by the activity.
 - 5. UCGP – Provide a separate SWPPP for UCGP compliance as determined by the Engineer when disturbing more than one acre of soil off the project site.
- B. The Contractor is responsible for costs of pursuing and obtaining clearances for areas not previously cleared and is not entitled to time extension for delays encountered in obtaining these clearances.
- C. Environmental clearances are required regardless of the property ownership.

3.8 DISCOVERY OF HISTORICAL, ARCHAEOLOGICAL, OR PALEONTOLOGICAL OBJECTS, FEATURES, SITES, OR HUMAN REMAINS

- A. Suspend work within the vicinity if historical, archaeological or paleontological objects, features, sites or human remains are discovered during construction:
 - 1. Provide a 100 ft minimum buffer around the perimeter of the discovery.
 - 2. Protect the discovery area.
 - 3. Contact the Engineer and send notice of the nature and exact location of the discovery.
 - 4. Provide written documentation to the Engineer within two calendar days of discovery.

- B. Do not recommence work within the area of discovery until the Engineer provides notice.

3.9 POLLUTION PREVENTION AND GENERAL HOUSEKEEPING

- A. Concrete Washout
 - 1. Provide a watertight container on site before concrete placement activities begin and where concrete trucks, tools and equipment are to be washed.
 - a. Size the container to prevent overflows
 - b. Do not place within 50 ft of storm drain inlets, open ditches or watercourses.
 - 2. Remove and properly dispose of concrete waste and washout water.
- B. Maintain active traffic lanes free from debris, such as mud, dirt, gravel and other material.
- C. Prevent material from entering in storm drain inlets and drainage pipes.

END OF SECTION

SECTION 01450
SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administrative and general requirements for project submittals.
 - 1. The technical specifications specify the required submittals for each item.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO LRFD Bridge Construction Specifications
- B. UDOT Structures Quality Control/Quality Assurance (QC/QA) Procedures

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Transmit each submittal with a transmittal form.
 - 1. Sequentially number each submittal on the transmittal form.
 - a. Number resubmittals with the original number and a sequential alphabetic suffix.
 - 2. Identify:
 - a. Project number, Project name, Structure number as applicable, Date, and Revision number.
 - b. Contractor, subcontractor and supplier, as applicable.
 - c. Pertinent drawing and detail number, and Specification Section and Title, as applicable.
 - d. Variations from Contract Documents and product requirements.
 - e. Changes made since previous submissions when revised for resubmission.
 - 3. Include a signature line for Contractor's signature indicating the submittal meets requirements.
- B. Schedule submittals to expedite the project and to coordinate submission of related items.

- C. Provide space for Contractor and Engineer stamps when submittals are for approval or review.
 - 1. Allow 4 inch by 4 inch space for Engineer stamp.
- D. Document format
 - 1. Submit electronically in PDF format.
 - 2. Drawings
 - a. Use 11 x 17 inch sheets.
 - b. Locate the title block in the lower right corner of each sheet.
 - 3. Engineering calculations
 - a. Use 8½ x 11 inch or 11 x 17 inch sheets.
 - b. Locate the title block at the top of 8½ x 11 inch sheets and at the lower right corner of 11 x 17 inch sheets.
 - 4. Other submittals
 - a. Use 8½ x 11 inch or 11 x 17 inch sheets.
- E. Place the following information in the title block of working drawings and supporting engineering calculations as applicable:
 - 1. State Project Number
 - 2. State Project Name
 - 3. State Structure Number
 - 4. Contractor, Fabricator, or Erector Name
 - 5. Contractor, Fabricator, or Erector Drawing Number
 - 6. Contractor, Fabricator, or Erector Sheet Number
- F. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah when specified.
 - 1. Drawings – Place the seal in the lower right corner of each sheet when engineering calculations are required to complete the design.
 - 2. Engineering Calculations – Place the seal on the calculation cover sheet.
 - 3. Other Submittals – Place the seal on the submittal cover sheet.
- G. Certify that engineering calculations for structure submittals have been checked according to the UDOT Structures QC/QA Procedures.
- H. Sign transmittal form certifying information is according to the requirements.
- I. Unsolicited submittals not required by the contract or requested by the Engineer may not be recognized or processed, and may be returned to the Contractor without review.

1.7 SUBMITTAL PROCEDURES

A. Submittals for approval

1. Allow the Department 14 calendar days for review each time the information is submitted.
2. The Department will return the submittal with one of the following dispositions:
 - a. Approved – Submittal is approved.
 - b. Approved as Noted – Submittal is approved provided listed conditions are met. Resubmit if conditions cannot be met.
 - c. Revise and Resubmit – Revise the submittal according to the markups and resubmit.
 - d. Rejected –The submittal is not approved.
 - e. Submit Specified Items – Submittal is incomplete. Resubmit with the specified items.
3. Receive approval before proceeding with work related to the submittal and perform work according to approved submittal.
 - a. The Department may reject work performed before submittal approval.
4. Resubmit for approval deviations from a previously approved submittal.
5. The Department may rescind approval at any time.
 - a. Stop related work if approval is rescinded and revise submittal to achieve approval.

B. Submittals for review

1. Allow the Department 14 calendar days for review each time the information is submitted.
2. The Department will return the submittal with one of the following dispositions:
 - a. No Exceptions Taken – Submittal is authorized for use.
 - b. Make Corrections As Noted – Submittal is authorized for use provided listed conditions are met. Resubmit if conditions cannot be met.
 - c. Revise and Resubmit – Revise the submittal according to the markups and resubmit.
 - d. Rejected –The submittal is not authorized for use.
 - e. Submit Specified Items – Submittal is incomplete. Resubmit with the specified items.
3. Receive authorization before proceeding with work related to the submittal and perform work according to authorized submittal.
 - a. The Department may reject work performed before submittal authorization.
4. Resubmit for review deviations from a previously authorized submittal.

5. The Department may rescind authorization at any time if it is discovered that the submittal does not meet contract requirements.
 - a. Stop related work if authorization is rescinded and revise submittal to achieve authorization.
- C. Submittals for information
 1. Provide information related to conformance with requirements before incorporating related work into the project.
 2. The Engineer will verify compliance with the contract requirements.
- D. Samples for selection
 1. Deliver samples with transmittal form to location determined by the Engineer.
 2. Allow 7 calendar days for the Department to make a selection.
- E. Samples for verification
 1. Deliver samples with transmittal form to location determined by the Engineer.
 2. Allow 7 calendar days for the Department to test the samples provided.

1.8 DRAWING & PLAN SUBMITTALS

- A. Working Drawings
 1. Shop drawings
 - a. Submit for review.
 - b. Provide sufficient detail to fabricate the member and to demonstrate contract compliance.
 - c. Provide the seal of a PE or SE licensed in the State of Utah when the Contractor designs the item or the Contractor completes the design for the item.
 - 1) Include supporting engineering calculations for items designed by the Contractor.
 - d. The seal of a PE or SE is not required when the complete details for the item are provided in the contract.
 2. Erection Drawings
 - a. Submit for review.
 - b. Include supporting engineering calculations.
 - c. Provide the seal of a PE or SE licensed in the State of Utah on drawings and calculations.
 3. Shipping Drawings
 - a. Submit for review.
 - b. Required for structural elements when specified, shown, or requested by the Engineer.
 - 1) Structural steel plate girder shipped on its side, for example.

- c. Include the following:
 - 1) Details and methods used to protect products from damage (overstress)
 - d. Include supporting engineering calculations.
 - e. Provide the seal of a PE or SE licensed in the State of Utah on drawings and calculations.
- 4. Drawings for Temporary Works.
 - a. Submit for review according to the following:
 - 1) When specified, shown, or requested by the Engineer.
 - 2) The height of falsework exceeds 14 ft or whenever traffic, other than workers involved in constructing the bridge, will travel under the bridge.
 - 3) Temporary bridges or bridge widenings that carry or span the travelled way.
 - 4) Temporary retaining walls that support or protect the travelled way.
 - b. Include detailed plans for items such as falsework, concrete forms, cofferdams, shoring, and temporary bridges.
 - c. Include design calculations and supporting data.
 - d. Design temporary works according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
 - e. Provide the seal of a PE or SE licensed in the State of Utah on drawings and calculations.
- 5. Demolition Plans
 - a. Submit for review when specified, shown, or requested by the Engineer.
 - b. Provide detailed plans depicting the proposed methods of removal of existing structures and structural elements.
 - c. Include supporting engineering calculations.
 - d. Provide the seal of a PE or SE licensed in the State of Utah on drawings and calculations.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 01455

MATERIAL QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials Acceptance
- B. Aggregate source sites

1.2 RELATED SECTIONS

- A. Section 02911: Wood Fiber Mulch
- B. Section 02922: Seed, Turf Seed, and Turf Sod

1.3 REFERENCES

- A. UDOT Materials Manual of Instruction
- B. UDOT Minimum Sampling and Testing Requirements
- C. Code of Federal Regulations (CFR)

1.4 DEFINITIONS – Not Used

1.5 SUBMITTALS

- A. Copies of test reports for all aggregate sources for approval – Refer to this Section, Articles 1.8B and 1.9B.
 - 1. Required tests are listed in the technical specifications.
- B. Materials site plan for approval for Department furnished aggregate sources. Refer to this Section, Article 1.8C.
- C. Property owner releases before physical completion. Refer to this Section, Article 1.10.
- D. Permission agreements for storing materials on private property. – Refer to this Section, Article 1.12D.
- E. Certifications of Compliance for information. – Refer to this Section, Article 1.14C.

- F. Cost documentation for use of foreign steel or iron for approval. – Refer to this Section, Article 1.14D.

1.6 MATERIALS ACCEPTANCE

- A. Acceptance of the work is based on a combination of inspection, sampling and testing, and manufacturer information.
1. Acceptance of a material does not occur until all requirements have been met and verified.
- B. Sampling and Testing
1. The Department verifies certain properties of work for acceptance using sampling and testing.
 2. Only those properties determined by a certain test are considered accepted by that test.
- C. Quality Management Plans
1. The Department pre-qualifies suppliers using the requirements in Quality Management Plans (QMP). A list of pre-qualified suppliers is maintained by the Department. Products delivered by suppliers who are not qualified or who lose qualification during the project, will be rejected.
 - a. Use a pre-qualified supplier according to the QMP listed for the following materials:
 - 1) Cement – QMP 502
 - 2) Reinforcing Steel Epoxy – QMP 503
 - 3) Reinforcing Steel – QMP 504
 - 4) Precast / Prestressed Concrete Structures – QMP 505
 - 5) Ready Mix Concrete – QMP 506
 - 6) Flyash and Pozzolon – QMP 507
 - 7) Asphalt Emulsion – QMP 508
 - 8) Asphalt Binder – QMP 509
 - 9) Hydrated Lime – QMP 510
 - 10) Reinforcing Steel Galvanized Coating – QMP 512
 - 11) Pavement Marking Paint – QMP 513
- D. Manufacturer Information
1. Certificates of Compliance
 - a. The contract designates manufactured materials and assemblies that can be incorporated in the work if accompanied by a manufacturer's Certificate of Compliance that includes the following:
 - 1) Project number and description, location, and Contractor's name;

- 2) Manufacturer's name, along with the material source location and point of manufacture or assembly;
 - 3) Identification of the party the material was sold or supplied to;
 - 4) Lot identification or manufacturer's identification of the certified materials or assemblies delivered to the project;
 - 5) Reference to the technical section or requirement of the contract specifications fulfilled through certification along with test reports, when applicable; and
 - 6) Statement that the material or assemblies comply with the particular requirements of the contract cited above and signed by a manufacturer's representative in a position to legally bind the manufacturer.
 - b. Items of work subject to Buy America require additional documentation. Refer to this Section, Article 1.14.
 - c. The Department may sample and test materials or assemblies used on the basis of Certificates of Compliance and reject if determined not to meet contract requirements.
 2. Manufacturer's product data sheets and installation instructions
 - a. The contract defines materials that may be incorporated into the project based on information provided through manufacturer's product data sheets and installation instructions.
 - b. Provide sufficient information to demonstrate conformance with product requirements before incorporating the product into the work
 - c. Installation instructions supplement Part 3 Execution requirements of technical Sections; in cases of conflict, the more stringent requirements apply.
 - d. The Approved Products List (APL) Compliance Form may be submitted in lieu of product data sheets and installation instructions if the product is listed in the Department's APL, except when product requirements have been modified by special provision.
 3. Other
 - a. Materials and products of work where method for verification for acceptance is not defined in the technical specification may be verified for conformance by any of the methods listed in this article, as determined by the Engineer.
- E. The Materials Manual of Instruction defines procedures for anyone performing certain tests for acceptance.
- F. The Department does not allow contract time extension for or as a result of testing.

- G. The Department may deduct costs for retesting of materials made necessary by the Contractor's activities from payment due.
- H. Laboratories and technicians must be qualified according to the requirements of the UDOT Materials Manual of Instruction to perform material sampling and testing.

1.7 SUPPLY SOURCE AND QUALITY REQUIREMENTS

- A. Notify the Engineer of the proposed source of materials to be used before their delivery.
- B. The Department encourages the re-use of industrial byproducts that meet contract requirements.
 - 1. Use new materials for the work in cases where industrial byproducts do not meet contract requirements.
- C. Required testing for aggregate sources will be deemed invalid unless testing occurred within a year of submittal.

1.8 DEPARTMENT FURNISHED AGGREGATE SOURCES

- A. Possible sources of local optional materials may be available.
 - 1. Expect variations in quantity and quality.
 - 2. Material may be rejected if it is unacceptable or does not meet contract requirements.
- B. Obtain authorization to use source material based on quality tests using a Department qualified laboratory.
- C. Prepare and obtain approval of materials site plans that show in detail the line and grades of material removal.
- D. Strip and stockpile topsoil before removing any materials.

1.9 CONTRACTOR FURNISHED AGGREGATE SOURCES

- A. Acquire the rights to remove materials and enter into agreement with owner that specifies requirements for grading and reclamation after removing materials.

- B. Perform required quality tests using a laboratory qualified by the Department.
 - 1. The Engineer may require additional samples for inspection and testing before authorizing use of the material.
- C. Meet the requirements established by Utah Division of Oil, Gas, and Mining and other agencies having jurisdiction over the operation of commercial material source sites.
- D. Strip and stockpile topsoil before removing any materials.

1.10 FINISHING AGGREGATE SOURCE SITES

- A. Finish all public and private material source sites to the satisfaction of the Engineer.
- B. Grade to drain without causing excessive erosion and without altering the natural drainage courses.
- C. Locate aggregate waste sites in areas that are least visible from public view.
 - 1. Spread aggregate waste material to obtain a natural appearance.
- D. Remove trash.
 - 1. Remove, bury, or distribute excess materials over the disturbed areas when excavation has been completed.
- E. Perform required grading and reclamation, as required under the agreement with the property owner, when removal of material is complete and before spreading topsoil.
 - 1. Avoid vertical cuts and sharp corners.
 - 2. Grade side slopes to achieve a natural appearance.
 - 3. Abandon and obliterate haul roads.
 - 4. Obtain release from property owner indicating that all conditions of the agreement between the Contractor and property owner are satisfied.
- F. Spread topsoil over the excavated area disturbed by construction operations including obliterated haul roads and seed all areas with grass or grasses adaptable to the area.
 - 1. Obtain required seed mix from Engineer.
 - 2. Seed and mulch according to Sections 02922 and 02911.

1.11 PLANT INSPECTION

- A. The Department may inspect and test materials at the acquisition, manufacturing, or supplying source for compliance with specified manufacturing methods.
- B. Cooperate fully and assist the Engineer during the inspection and testing.
 - 1. Allow the Engineer full access to all parts of the plant used to manufacture or produce materials.
 - 2. Provide and maintain adequate safety measures.
 - 3. Provide mechanisms for providing samples during inspections.
 - a. Equip crushing or screening facilities with automatic or semiautomatic mechanical sampling devices.

1.12 MATERIAL STORAGE AND HANDLING

- A. Store and handle materials according to manufacturer requirements.
- B. Transport bulk materials in a manner to prevent loss or segregation after loading and measuring.
- C. Store materials so they can be easily inspected and tested.
- D. Furnish copies of the permission agreements to store materials on private property to the Engineer if requested.
- E. Restore storage and plant sites to their original condition.
- F. Do not store materials and equipment on bridge decks and in areas that add loads to bridge elements.

1.13 DEPARTMENT FURNISHED MATERIALS

- A. Schedule, pickup, and deliver Department furnished materials to install at the specified site.
 - 1. Receive, inventory, store, protect, distribute and install at site as specified.
- B. Contractor is responsible for all materials received. The Department deducts from any money due:
 - 1. Any shortages, deficiencies, and damage that may occur to the material after physical transference from the Department.
 - 2. The demurrage charges resulting from failure to accept the material at the designated time and point of delivery.

- C. The terms Department furnished, State furnished, and owner furnished are used interchangeably throughout the contract documents to mean components for specific use in the project that are provided by an entity other than the Contractor.

1.14 BUY AMERICA

- A. Federal-aid projects are subject to Title 23 CFR Part 635.410, Buy America Requirements.
 - 1. Check the appropriate box on the bid proposal indicating the intent to use steel or iron or both of 100 percent domestic supply or with some foreign supply.
 - 2. The Department considers the bid a bid for furnishing domestic steel and iron if neither box is checked.
 - 3. The Department awards the Contract to the bidder who submits the lowest total contract bid based on furnishing domestic steel and iron unless the total contract bid exceeds the lowest total contract bid based on foreign steel and iron by more than 25 percent.
- B. All products manufactured from steel and iron must be manufactured in the United States to be considered domestic.
 - 1. All manufacturing processes of the steel and iron material in a product such as melting, rolling, extruding, machining, bending, grinding, drilling, and coating must occur within the United States.
 - 2. Coating includes all processes that protect or enhance the value of the material to which the coating is applied. The material applied as a coating is not subject to Buy America.
- C. Submit Certifications of Compliance of materials before delivery to site.
 - 1. Include as a minimum the following information for Certifications of Compliance for Buy America:
 - a. Signed mill test report.
 - b. Signed certification by each Fabricator and Manufacturer that has handled the steel or iron product affirming that every process, including the application of a coating, performed on the steel or iron product has been carried out in the United States.
 - c. Material descriptions, quantities, and means of material identification such as heat numbers, lot numbers, and other industry identification markings for each process the material underwent so the final product can be tracked through a step process from smelting to final product.
 - d. Tracking quantities is not required for coating operations and for mill certifications.

2. Include all steel or iron materials that can't be substantiated as being of domestic origin in cost documentation for foreign steel or iron.

D. The above requirement does not preclude a minimal use of foreign steel or iron, provided the cost of the steel or iron used does not exceed one tenth of one percent (0.1 percent) of the total contract amount or \$2,500, whichever is greater.

1. Track the use of all permanent foreign steel incorporated in the project.
2. Provide satisfactory cost documentation to the Engineer before payment and incorporation of the materials into the project when foreign steel or iron is used as allowed by this article.
 - a. Cost documentation is the material invoices documenting the material cost to the Contractor from the supplier as delivered to the site, not the Contractor's bid price.

E. The following are exempt from Buy America except as noted:

1. Temporary steel or iron materials.
2. Materials left in place for the Contractor's convenience that could be removed without damaging the completed work
3. Items such as nuts, bolts, washers, screws, concrete chairs, spacers, mailboxes, and other steel or iron parts that may be considered miniscule or non-structural to the whole of the project.
4. Fencing stays, clips, staples, or other miscellaneous fencing components.
5. Manufactured assemblies that are less than 51 percent by weight steel or iron content when it is delivered to the job site for installation.
 - a) Precast items such as pipe, manholes, and drainage boxes must meet the Buy America requirements.
6. The major steel and iron components of the following and other similar assemblies must meet the requirements of Buy America:
 - a) Guardrail, guardrail posts, end sections, terminals, cable barrier, steel or iron pipe, conduit, grates, manhole covers and risers, mast arms, poles, standards, trusses, supporting structural members for signs, luminaires, and traffic control systems.

1.15 CONVICT PRODUCED MATERIALS

- A. Federal-aid projects are subject to Title 23, Code of Federal Regulations, CFR Part 635.417, Convict Produced Materials.
- B. Materials produced after July 1, 1991, by convict labor may only be incorporated in a Federal-aid highway construction project if such materials have been:
 - 1. Produced by convicts who are on parole, supervised release, or probation from a prison.
 - 2. Produced in a qualified prison facility and the cumulative annual production amount of such materials for use in Federal-aid highway construction does not exceed the amount of such materials produced in such facilities for use in Federal-aid highway construction during the 12-month period ending July 1, 1987.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01456

MATERIALS DISPUTE RESOLUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedures for disputing acceptance or verification test results for the following materials on Department projects:
 - 1. Section 02056 – Embankment, Borrow, and Backfill
 - 2. Section 02721 – Untreated Base Course
 - 3. Section 02735 – Microsurfacing
 - 4. Section 02741 – Hot Mix Asphalt
 - 5. Section 02743 – Hot Mix Asphalt – Bike and Pedestrian Paths
 - 6. Section 02744 – Stone Matrix Asphalt
 - 7. Section 02745 – Asphalt Material
 - 8. Section 02752 – Portland Cement Concrete Pavement
 - 9. Section 02785 – Chip Seal Coat
 - 10. Section 02786 – Open-Graded Surface Course
 - 11. Section 02787 – Bonded Wearing Course
 - 12. Section 03055 – Portland Cement Concrete
 - 13. Section 03310 – Structural Concrete
- B. Procedures for requesting that rejected, non-conforming material be allowed to remain in place.

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress
- B. Section 00727: Control of Work
- C. Section 02056: Embankment, Borrow, and Backfill
- D. Section 02721: Untreated Base Course
- E. Section 02735: Microsurfacing
- F. Section 02741: Hot Mix Asphalt
- G. Section 02743: Hot Mix Asphalt – Bike and Pedestrian Paths
- H. Section 02744: Stone Matrix Asphalt

- I. Section 02745: Asphalt Material
- J. Section 02752: Portland Cement Concrete Pavement
- K. Section 02785: Chip Seal Coat
- L. Section 02786: Open-Graded Surface Course
- M. Section 02787: Bonded Wearing Course
- N. Section 03055: Portland Cement Concrete
- O. Section 03310: Structural Concrete

1.3 REFERENCES

- A. AASHTO R 35: SuperPave Volumetric Design for Hot Mix Asphalt (HMA)
- B. AASHTO T 22: Compressive Strength of Cylindrical Specimens
- C. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- D. AASHTO T 121: Density, Yield, and Air Content of Concrete
- E. AASHTO T 152: Air Content of Freshly Mixed Concrete by the Pressure Method
- F. AASHTO T 193: The California Bearing Ratio
- G. AASHTO T 324: Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)
- H. AASHTO T 342: Determining Dynamic Modulus of Hot Mix Asphalt (HMA)
- I. ASTM C 457: Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- J. UDOT Materials Manual of Instruction
- K. UDOT and Utah AGC Partnering Field Guide

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

- A. Contractor's dispute of acceptance or verification test results.
 - 1. Submit the dispute for approval within one week of receipt of test results or at least 24 hours before performing any work that may prevent the evaluation, correction, or removal of the lot in question.
 - 2. Include information, engineering analysis, statistical analysis, and test results related to the dispute.
 - a. Reasons for disputing the acceptance or verification test results.
 - b. The Contractor's project quality control test results, including split sample test results.
 - 1) Test results must be from a Department-qualified laboratory using Department-qualified technicians.
 - 2) Include all supporting test data and calculations for reported values.
 - c. Successful laboratory correlation information when required by material specification.
 - d. Statistical analysis or identification of potential outliers.
 - e. Procedures or issues leading to disputed acceptance test results.
 - f. Incentive/Disincentive calculations based on both Contractor and Department test values, separately.
- B. Request to allow rejected material to remain in place
 - 1. Submit the request for approval within one week of receipt of test results or at least 24 hours before performing any work that may prevent the evaluation, correction, or removal of the lot in question.
 - 2. Submit an engineering analysis.
 - a. Include reasons that the Department should consider allowing the rejected material to remain in place.
 - b. Include materials, durability, and long-term structural properties from a Department-qualified laboratory as appropriate. Testing may include:
 - 1) Hamburg Wheel Track Testing of Compacted Bituminous Mixtures – Refer to AASHTO T 324.
 - 2) PG Asphalt Binder Tests – Refer to Section 02745.
 - 3) SuperPave Volumetric Properties – Refer to AASHTO R 35.
 - 4) California Bearing Ratio – Refer to AASHTO T 193.

- 5) In-place Concrete Properties for Concrete Pavement and Portland Cement Concrete – Refer to AASHTO T 22, T 24, T 121, T 152. Samples from reinforced structures may be taken only as approved by the Engineer.
 - 6) Air Void System in Hardened Concrete – Refer to ASTM C 457.
- c. Include an engineering evaluation based on durability and serviceability relative to the specified product requirements. This includes expected performance compared to design life.

1.6 DISPUTE RESOLUTION PROCEDURE FOR ACCEPTANCE OR VERIFICATION TEST RESULTS

- A. The Contractor may dispute the validity of the Department's acceptance or verification tests.
 1. The option to dispute the validity of the Department's test results is forfeited if laboratory correlation testing is required by specification and is not performed.
- B. Contractor disputes will not change the Department-selected option for materials acceptance based on sampling and testing as outlined in the UDOT Materials Manual of Instruction Section 1011.
 1. Quality Control results may be used to dispute acceptance test results.
- C. The Department immediately reviews the submittal when the construction schedule and contractor information indicates that a rejected lot will be affected within 48 hours by work that may prevent the evaluation, correction, or removal of the lot in question.
 1. The Department may suspend work related to the lot in question if merit is found in the engineering analysis.
- D. Resolve differences in test results prior to further production of the material type in question.
- E. The Department and Contractor immediately begin to investigate and review the engineering analysis and resolve the dispute if merit is found. The investigation includes the following.
 1. A test and calculation procedure review. Refer to this Section, Article 1.7.
 2. Validation testing as appropriate. Refer to this Section, Article 1.8.
 3. Third party testing and review as appropriate. Refer to this Section, Article 1.9.

- F. The Department may choose to evaluate the lot using appropriate test methods if significant errors are identified that cannot be corrected and the quality of the in-place material is in question.
- G. The Engineer reviews the analysis and notifies the Contractor in writing of their decision. The notification of rejection includes the following:
 - 1. Engineering basis for rejecting the Contractor's analysis including specific points of objection.
 - 2. Department data and analysis to justify Department position.
 - 3. Time frame for removal of material or pay adjustment to be applied to the lot.
- H. The Department will review the Contractor's schedule and make appropriate adjustments to contract time when significant errors are identified in the Department's testing results based on critical path analysis. Refer to Section 00555.
 - 1. Time lost due to a rejected analysis is not credited to the contract time.
- I. The Department's response concludes this materials dispute resolution process.
 - 1. Continuing disputes must be addressed and escalated as outlined in Section 00727 and the UDOT and Utah AGC Partnering Field Guide.

1.7 TEST AND CALCULATION PROCEDURE REVIEW FOR DISPUTED ACCEPTANCE OR VERIFICATION TEST RESULTS

- A. The Department and Contractor immediately begin a review of the acceptance test results when the Department concludes the engineering analysis has merit and test procedures or calculations are in question. The review normally includes the following in an appropriate order:
 - 1. A review of all equipment, procedures, and methods used for sampling, splitting, and testing.
 - 2. A review of the Department and Contractor's raw test data and calculations for documentation or calculation errors.
 - 3. Production and testing of additional correlation samples.
 - 4. Cross-witnessing of test procedures by Contractor Quality Control and Department personnel.
 - 5. Distribution of any other pertinent information.
 - 6. Discussion of other possible means for variation.
- B. The Department corrects the applicable test results and reapplies the acceptance determination and associated payment if equipment issues or errors in calculations or reporting are discovered.

- C. The Department evaluates the lot using the original test results if no significant errors are identified.

1.8 VALIDATION TESTING FOR DISPUTED ACCEPTANCE OR VERIFICATION TEST RESULTS

- A. Validation testing may be performed by the Department as follows:
 - 1. Department personnel begin retesting on the material remaining from the original Department test.
 - a. The Contractor's representative may witness the testing.
 - b. The Department may perform the validation testing in the Department's Region or Central Materials laboratory.
 - c. Retest all samples in the lot.
 - 2. Retesting results are used to validate or invalidate original Department result.
 - a. Validation test results may not be used instead of acceptance results.
 - b. Results within two standard deviations of the original acceptance results are validated.
 - 1) Use the project acceptance results for the lot in question to determine the standard deviation.
 - 3. Invalidated test results are removed from acceptance lot and the lot is reevaluated based on the reduced sample size.
- B. The Department evaluates the lot using the original test results if no samples are invalidated.

1.9 THIRD PARTY TESTING AND REVIEW FOR DISPUTED ACCEPTANCE OR VERIFICATION TEST RESULTS

- A. Third Party testing may be performed as follows:
 - 1. Select an Independent Third Party agreed upon by the Department and the Contractor to witness sample splitting and testing by both the Contractor and the Department if errors in testing cannot be identified.
 - 2. The Independent Third Party identifies and obtains additional material for split-sample testing.
 - 3. The Independent Third Party witnesses split-sample testing in the Department and Contractor Laboratories, evaluates the test procedures, compares the results, determines if there are errors, and provides a report.
 - 4. The party responsible for the identified error pays for the services of the Independent Third Party.
- B. The Department evaluates the lot using the original testing results if no significant errors are identified.

1.10 REJECT MATERIAL

- A. The Contractor may request that rejected, non-conforming material be left in place at a reduced price. Include an engineering analysis.
- B. The Engineer determines whether the lot is to be removed or remain in place and the associated price reduction if other than specified in the contract.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01501

MOBILIZATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mobilization and preparatory work necessary to become ready to perform the work.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 GENERAL

- A. Includes the moving of personnel, equipment, supplies and incidentals to each work site before beginning the work.
- B. Includes the establishment of offices, buildings, and other facilities necessary for the work.
- C. Includes labor and operations which must be performed before beginning other items under the Contract.
- D. Includes removal of personnel, equipment, and supplies from each work site at the completion of the work.
- E. Includes work that is not included with other items under the Contract such as cleanup and restoration of disturbed areas.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01540

PUBLIC INFORMATION SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Responsibilities of Contractor Public Information Coordinator (PIC) for the length of a project.

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress
- B. Section 01554: Traffic Control

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PERFORMANCE REQUIREMENT

- A. Designate the PIC at the project pre-construction conference.
 - 1. Responsible for project public information services.
 - a. PIC duties take precedence over other assigned duties.
 - b. PIC must not be the project superintendent.

1.7 PIC RESPONSIBILITIES

- A. Establish a local public information office. Office may be located within the Contractor's regular office provided that the telephone number is a local call or toll-free number for project stakeholders.
 - 1. Maintain established working hours and days.
 - 2. Provide a telephone or cell phone with voice mail capability dedicated to project public information services.
- B. Maintain daily communication with the Engineer.
- C. Maintain and document weekly communications with Region Public Involvement Manager, affected residents, businesses, organizations, and public agencies such as local emergency services, public works, transit authorities, city offices, and other stakeholders.

- D. Maintain telephone availability.
 - 1. Maximum 12 hour response time during project working hours.
 - 2. On-call status required during non-working hours.
- E. Develop a database of stakeholders and stakeholder contact information including name, address, phone number, e-mail address, and fax number.
- F. Establish method of producing and distributing printed fliers and e-mail information.
- G. Organize, participate in, and document public and private meetings involving project when requested by the Engineer.
- H. Refer to Section 00555.

1.8 PAYMENT PROCEDURES

- A. Department makes:
 - 1. Partial payments for the pay item Public Information Services as the work progresses when the Contractor provides public information services according to this specification.
 - 2. Payments based on a percentage of project completion.
- B. The Engineer and the Region Public Involvement Manager monitor and evaluate the Public Information Coordinator and all public information services. Failure to provide public information services according to this specification results in a weekly deduction of between \$1,000 and \$10,000.

PART 2 PRODUCTS

2.1 OFFICE SPACE AND EQUIPMENT – GENERAL

- A. Office Space
- B. Telephone Services
- C. Labor and material required to perform the duties and responsibilities of this section.

PART 3 EXECUTION

3.1 ESTABLISH LOCAL PUBLIC INFORMATION SERVICES

- A. Provide office address and local or toll-free telephone number.
 - 1. Establish and publish office hours, working days, telephone number, and e-mail address.
 - a. Answer all e-mail within 12 hours of receipt during business hours.
- B. Provide voice mail service.
 - 1. Update message with project information a minimum of once each week concerning the activities on the project.
 - 2. Provide public information office hours.
 - 3. Opportunity for caller to leave a recorded message.
 - 4. Check voice mail a minimum of twice daily.
 - 5. Document and respond to messages within 12 hours of receipt.
- C. Maintain a logbook.
 - 1. Communication information.
 - a. Date, time
 - b. Contact information
 - 1) Name, phone number, address, and e-mail address
 - c. Description of inquiry or request
 - d. Response
 - e. Subsequent responses or actions taken during construction
 - 2. Follow up all inquiries with a phone call, in writing, or with a meeting as required.
 - 3. Document discussions, resolutions, and actions.
 - a. Provide weekly copies of logbook documentation to the Engineer and Region Public Involvement Manager.
- D. Develop and maintain database of stakeholders and stakeholder contact information including name, address, phone number, e-mail address, and fax number.
 - 1. Make database available for review by the Engineer and Region Public Involvement Manager at all times during the project
 - 2. Deliver to the Region Communications Manager upon completion of the project.
- E. Respond to questions concerning project activities and schedules.

- F. Organize, participate, and document meetings held with affected individuals and organizations.
 - 1. Provides meeting minutes to Engineer and Region Public Involvement Manager in a weekly report.
- G. Maintain and document weekly communication and project updates with the following:
 - 1. Department, Region, and Public Involvement Manager
 - 2. Affected local public agencies
 - a. Emergency Service Agencies
 - 1) Fire Departments
 - 2) Police Departments and Highway Patrol
 - 3) Ambulance Services
 - b. Local city offices
 - c. Public works departments
 - d. Local transit authorities
 - e. Local school districts
 - f. Local U.S. Post Office
 - 3. Affected businesses
 - 4. Affected trucking and carrier associations
 - 5. Local organizations interested in the project
 - 6. Private citizens when requested
 - 7. Engineer and Region Public Involvement Manager, providing copies of logbook documentation
 - 8. Other stakeholders as required
- H. Prepare and distribute information to all stakeholders within one block of the construction zone in flier format or through documented personal contact one week before beginning construction and subsequently each week until the end of the project.
 - 1. Provide copies of all fliers, e-mail, or other materials containing project information to the Engineer and the Region Communications Manager for review before distribution.
 - 2. Include the following information in the flier:
 - a. Project name
 - b. Description of work to be done including completion dates
 - c. Work locations
 - d. Lane restrictions and directions
 - e. Traffic management plans or detours
 - f. Work times and days of the week
 - g. Impacts to access
 - h. Schedule for coming week
 - i. Name of the Contractor's Public Information Coordinator, telephone number, and office hours of the Public Information Office.

3. Communicate construction changes to established weekly schedule to all affected stakeholders. Provide draft copy of changes to Engineer before distribution.
- I. Provide telephone number to sign manufacturer or Traffic Control Maintainer for placement on Construction Zone Information Sign. Refer to TC Series Standard Drawings and Section 01554.
- J. Provide telephone number to sign manufacturer or Traffic Control Maintainer for placement on a "Project Notification Sign" according to TC Series Standard Drawings with legend (text) determined in coordination with Region Public Involvement Manager.
- K. Provide updates to the Engineer and Region Public Involvement Manager on project activities that affect traffic and access.
- L. Forward all media inquiries, written and verbal, regarding the project or project activities to the Region Public Involvement Manager or the Department Communications Office.

END OF SECTION

SECTION 01554

TRAFFIC CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Traffic Control Plan requirements and materials and labor necessary for implementation.
- B. Traffic Control Maintainer and Flagging.
- C. Work zone traffic control devices, arrow boards, and pilot cars.

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress
- B. Section 02845: High Tension Cable Barrier
- C. Section 02890: Retroreflective Sheeting

1.3 REFERENCES

- A. AASHTO Roadside Design Guide, Current Edition
- B. American National Standards Institute (ANSI)
- C. Americans with Disabilities Act
- D. ATSSA: American Traffic Safety Services Association
Quality Standards for Work Zone Traffic Control Devices
- E. Department Flagger Training Handbook
- F. Department Guidelines for Crash Cushions and Barrier End Treatments
- G. International Safety Equipment Association (ISEA)
- H. NCHRP- Report 350 Recommended Procedures for the Safety
Performance Evaluation of Highway Features
- I. Utah Manual on Uniform Traffic Control Devices (Utah MUTCD)

1.4 DEFINITIONS

- A. Peak Hours –Peak hours are 6:30 a.m. to 9:00 a.m. and 3:30 p.m. to 7:00 p.m., Monday through Friday unless otherwise defined by the Engineer or in the Special Provision for Section 00555.
- B. Traffic Slow Down – An isolated planned event where traffic on a highway is reduced in speed to provide a gap for work to proceed.
 - 1. Examples include the crossing of the highway with heavy equipment or the adjustment of traffic control devices.
- C. TPRS – Temporary Portable Rumble Strips – An array of 3 heavy rubber strips that create noise when they are run over and are used to alert drivers to the presence of road construction.

1.5 SUBMITTALS

- A. Traffic Control Plan for review no later than the fourth Wednesday following Notice to Proceed.
 - 1. 11 inches x 17 inches format prepared using CAD software.
 - 2. Refer to this Section, Article 1.8 Paragraph G for required documentation.
 - 3. Refer to this Section, Article 3.1 Paragraph A for modified plan submittal requirements.
- B. Traffic Control Inspection forms for information. Refer to this section, Article 1.9, paragraph C10.
- C. Each phase of construction must use an authorized Traffic Control Plan. Submit an updated plan to the Engineer for review if a construction phase is proposed that is not covered by the Traffic Control Plan.
- D. Submit plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented.
- E. Do not begin work until the Traffic Control plan is authorized for use and has been fully implemented.
- F. Implement changes required to meet Department Standard Specifications, Standard Drawings and Utah MUTCD.
 - 1. Comply with this Section, Article 1.6, paragraph A1.

1.6 REQUIRED MEETING

- A. Attend a meeting at the time and location determined by the Engineer:
 - 1. Contractor's Traffic Control Designer
 - 2. Contractor's Traffic Control Maintainer

1.7 CERTIFICATIONS

- A. Use devices and systems that meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration.
 - 1. Category 1 (cones, barrels and delineators), Category 2 (barricades and sign stands) and Category 3 (Barriers, crash cushions and truck mounted attenuators) – Must meet NCHRP-350.
 - 2. Category 4 – Arrow board and portable variable message signs do not have to meet NCHRP-350 Report test requirements.
- B. Devices may meet MASH 2016 criteria instead of NCHRP-350 Report requirements.

1.8 TRAFFIC CONTROL REQUIREMENTS

- A. Meet the following requirements for traffic control and document them in the traffic control plan:
 - 1. Provide for the safe movement of traffic.
 - a. Plan must meet or exceed all standards set in the Utah MUTCD, Standard Drawings, Standard Specifications, and other contract documents for safe movement of traffic.
 - 2. Provide for the efficient movement of traffic.
 - a. Address expected delay with the Project Public Involvement Team or the Region Communications Manager if the project does not have a Public Involvement Team.
 - 3. Provide for the safe and efficient movement of pedestrians and bicycles.
 - a. Meet all requirements of the Americans with Disabilities Act and the Utah MUTCD.
 - 4. Provide concrete barrier, crash cushions and attenuators including:
 - a. Protection as required for hazard mitigation for workers. Refer to TC 3 Series Standard Drawings.
 - b. Protect all hazards to motorists within the appropriate AASHTO clear zone including bridge parapets, barrier blunt ends, poles, and large equipment. Refer to the Department Guidelines for Crash Cushions and Barrier End Treatments for acceptable devices.

5. Provide temporary pavement markings and pavement marking removal.
6. Incorporate traffic signal timing and detection plans as determined by the Engineer.
7. Incorporate TPRS when there is a change in the width, alignment or number of lanes on freeways or interstates with 2 lanes in a single direction.
 - a. Use TPRS only when the traffic control maintainer or other observer is present to adjust TPRS when they shift under traffic.

1.9 TRAFFIC CONTROL PLAN REQUIREMENTS

- A. Provide a Traffic Control Plan signed and sealed by a professional engineer licensed in the State of Utah.
- B. Format and document the Traffic Control Plan to include all information necessary to successfully implement, including:
 1. Describe each phase of work, including all elements of work to be accomplished in each phase.
 2. Show each change to traffic control that is planned for the duration of the project,
 3. Document expected duration of each traffic control configuration.
 4. Use CAD for any drawings.
 5. Use the same or greater level of detail as in the Utah MUTCD and TC Series Standard Drawings.
 6. Calculate and document Length of Need (LON) for temporary barriers.
 7. Show taper lengths and lane shift widths, device spacing, sign locations for temporary and existing signs.
 8. Document removal or masking of things such as existing traffic signs, traffic signals, and markings.
 9. Document worker parking, work vehicle access, and equipment access.
 10. Document the location and hours of use for TPRS.

1.10 TRAFFIC CONTROL MAINTAINER

- A. Certified by the Department or by the American Traffic Safety Services Association (ATSSA) with the Department endorsement as a Traffic Control Technician. A list of certifying agencies is available at <http://www.udot.utah.gov/go/standardsreferences>

- B. Authority
 - 1. Obtains and uses all labor, equipment, and materials necessary to maintain traffic control.
 - 2. Changes traffic control operations according to the traffic control plan.
- C. Responsibilities and Duties
 - 1. Oversees all traffic control operations.
 - 2. Will be present and active participant during the installation, maintenance, and removal of Temporary Traffic Control Devices.
 - 3. Implements the Traffic Control Plan.
 - 4. Remains available 24 hours a day, seven days a week and can be on-site within 30 minutes of notification.
 - 5. Corrects deficiencies immediately upon notification from the Engineer.
 - 6. Document the traffic control inspections on a form acceptable to the Engineer. Inspect at least four times each day with at least one of the inspections conducted during nighttime hours:
 - a. Before beginning of shift,
 - b. At mid-shift,
 - c. Half-hour after shift ends, and
 - d. At the midpoint of the off-shift period.
 - 7. Coordinate project traffic control with emergency services and local law enforcement agencies.
 - 8. Inspect and document traffic control inspections twice each day when no construction work is being done.
 - a. Once during daylight hours and once during nighttime hours.
 - b. Conduct inspections a minimum of eight hours apart.
 - 9. Complete a daily record of traffic control activities using a form acceptable to the Engineer.
 - 10. Submit inspection and activities forms to the Engineer each week on a day and time acceptable to the Engineer.
 - 11. Monitor traffic queue lengths and adjust advanced warning signs to provide adequate warning of the actual back of queue resulting from construction activities.
 - 12. Adjust the TPRS as necessary to maintain proper alignment, spacing and location.

1.11 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL

- A. Implement and maintain traffic control according to the Traffic Control Plan.
 - 1. Implement changes to traffic control required in order to meet UDOT Standard Specifications, Drawings, and Utah MUTCD.

2. Coordinate changes to traffic control and the Traffic Control Plan with the Engineer prior to implementation.
- B. Meet all requirements of this Section, Article 1.9 when traffic control devices are required to be in place when work is not actively occurring, including overnight, weekends and holidays.
- C. Meet the acceptable classification as identified by Quality Standards for Work Zone Traffic Control Devices published by ATSSA for traffic control devices.
 1. Wash devices as needed so that the proper retroreflectivity is maintained.
- D. Maintain traffic control devices during and after all snow plowing operations.
 1. Clear snow away from all traffic control devices so that the devices function as intended.

1.12 PAYMENT PROCEDURES

- A. Partial Payments – Based on the percentage of the project completed, excluding the cost of traffic control.
- B. Price Adjustments
 1. The Department reduces payment when traffic control is not in compliance with the Traffic Control Plan or when the Contractor fails to meet all requirements cited or referenced in this specification.
 - a. The amount per day by which the Contractor's compensation will be reduced is calculated using the daily charge for Calendar Day in the Schedule of Liquidated Damages in Table of Section 00555 or the Contract lump sum bid price for Traffic Control divided by the number of contract days, whichever is greater.

PART 2 PRODUCTS

2.1 PILOT CAR

- A. Equip with a retroreflectorized sign.
 1. Refer to Section 02890.
 2. Utah MUTCD sign G20-4.

- B. Equip with a minimum of two rotating lights, oscillating, or strobe lights.
 - 1. Minimum 4 inch diameter/width and minimum 6 ft mounting height.
 - 2. Yellow color.

2.2 FLAGGER EQUIPMENT AND CLOTHING

- A. Refer to the Department's Flagger Training Handbook.
- B. Refer to TC Series Standard Drawings.
- C. Safety Clothing
 - 1. Flagger vest and hard hat – Orange, red-orange, or fluorescent version of these colors.
 - a. Wear safety apparel for daytime and nighttime activity meeting the requirements of ANSI/ISEA "American National Standard for High-Visibility Apparel and Headwear" or equivalent revisions and labeled as meeting the ANSI 107-2004 (or equivalent ANSI/ISEA publication year) standard performance for Class 2 risk exposure.
 - 1) Wear safety apparel meeting the requirements of ANSI/ISEA "American National Standard for High-Visibility Apparel and Headwear" or equivalent revisions and labeled as meeting the ANSI 107-2004 or current ANSI/ISEA publication year, standard performance for Class 3 risk exposure for nighttime activity.
 - b. Hard hat with 10 square inches of white or strong yellow-green retroreflective tape placed around the base of the hard hat and visible to traffic from all directions.

2.3 TRAFFIC CONTROL SIGNING AND DEVICES

- A. Signs
 - 1. Comply with Section 02890.
 - 2. Comply with TC Series Standard Drawings.
 - 3. Comply with SN Series Standard Drawings when using post mounted signs.
- B. Channelizing Devices
 - 1. Comply with TC Series Standard Drawings.
 - 2. Comply with Section 02890.

- C. Precast Concrete Barrier
 - 1. Comply with TC Series Standards Drawings.
 - 2. Use an approved construction zone attenuator or permanent style end sections, as listed in Department Guidelines for Crash Cushions & Barrier End Treatments.
 - a. Use a construction zone attenuator when approach ends of temporary precast barrier are within the maximum AASHTO clear zone.
 - 1) Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements
 - 2) Refer to the CC Series Standard Drawings and manufacturer's recommendations to install crash cushions.
- D. Use properly rated truck-mounted attenuator for the posted speed limit prior to construction.
 - 1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
 - 2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.
 - 3. Do not use a truck-mounted attenuator (TMA) to protect blunt end for more than 72 hours.
- E. Maintain cable barrier and anchor systems during construction.
 - 1. Protect existing hazards when cable barrier and anchor systems are rendered inoperable by work.
 - a. Address barrier length of need for the hazard.
 - 2. Maintain the required tension in the cable barrier system when the cable is disconnected by installing anchor systems on each end of the disconnect.
 - a. Do not cut cable.
 - 1) Disconnect cable at cable splice or anchor system locations only.
 - 3. Install NCHRP 350 approved terminal compatible with existing cable system. Refer Section 02845.
 - a. Tension cable to manufacturer's requirements.

2.4 ARROW BOARD

- A. Comply with all standards as specified in the Utah MUTCD, Section 6F.61 Arrow Boards.
- B. Refer to the TC Series Standard Drawings and the Utah MUTCD.

2.5 TEMPORARY PORTABLE RUMBLE STRIPS

- A. Roadquake 2 Series
Temporary Portable Rumble Strip manufactured by:
Plastic Safety Systems
2444 Baldwin Road
Cleveland, OH 44104
(800) 662-6338
- B. Space and locate TPRS as shown in TC Series Standard Drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. Follow the authorized Traffic Control Plan.

3.2 FLAGGING

- A. Flaggers must have a current Utah flagging certificate and must present proof of certification upon request by the Department.
 - 1. Acceptable certifications. Refer to <http://www.udot.utah.gov/go/standardsreferences> for a list of acceptable courses taught by certified instructors.

3.3 TRAFFIC CONTROL SIGNING AND DEVICES

- A. Use posted speed limit prior to construction to compute sign spacing, taper lengths, buffer zones, and construction clear zone.
 - 1. Use plastic drums or directional barricades for lane closure taper devices for speeds 50 mph and greater.
 - 2. Refer to the TC Series Standard Drawings for use of cones or tubular markers at night.
- B. Use pre-construction posted speed during construction to compute the tangent spacing for channelizing devices.
- C. Remove all traffic control from site of work that are no longer necessary for the Traffic Control Plan.
 - 1. Remove traffic control devices from the roadway a distance twice that of the Work Clear Zone if they will be used within 24 hours of the daily work stoppage and are not required for immediate traffic control. Refer to the TC Series Standard Drawings.
 - a. Obtain written permission from property owner prior to storing traffic control devices on private property.

2. Cover post mounted signs completely with an opaque and durable covering when the signs are not applicable.

3.4 ARROW BOARD

- A. May substitute Type C units for Type B units. Refer to the TC Series Standard Drawings.
- B. Do not substitute Type B units for Type C units.
- C. Remove Arrow Board from the site of work when not needed for the control of traffic within a four-hour period.

3.5 TRAFFIC SIGNALS

- A. Use uniformed police officer when construction activities are impacting an operating signalized intersection.
- B. Use of flaggers at traffic signals permitted when the signals have been turned to red flash mode or are inoperable.
 1. Control each approach by separate flaggers.
 - a. Flaggers can control only two lanes of approach traffic.
 - 1) Third lane control permitted when left or right turn bays present.
- C. The Department will make all changes to traffic signal operations.

3.6 CONSTRUCTION ZONE SPEED LIMIT REQUIREMENTS

- A. Obtain approval for regulatory and advisory speed reductions through the Engineer.
 1. Use speed reductions only during impacted times and areas.
 2. Restore existing regulatory speed limit prior to work at locations where traffic is not being impacted by work activities.
 3. Refer to <http://www.udot.utah.gov/go/standardsreferences> for policy information.
 4. Refer to TC Series Standard Drawings.
 5. Use speed reduction only when construction activities impact traffic.
 6. Restore regulatory speed limit at locations where construction activities are not impacting traffic.
 7. Refer to SN Series Standard Drawings for post mounted sign requirements.

3.7 LIMITATION OF OPERATIONS

- A. Traffic Slow Down
 - 1. Notify and obtain approval from the Department and law enforcement a minimum of 48 hours prior to slow down.
 - 2. Use a Highway Patrol Trooper, or other law enforcement officer, in a marked vehicle with overhead flashing lights to conduct the slow down.
 - 3. Use the officer in the marked vehicle to slow down one or two lanes.
 - a. Use, in any combination either, contractor-supplied vehicles equipped with overhead amber flashing lights or additional officers in marked vehicles at the rate of one vehicle per lane thereafter for all lanes of the highway to affect the traffic slow down.
 - 4. Additional vehicles as described in this article may be used in the traffic slow down to supplement the law enforcement vehicle when required by the officer.
 - 5. The duration of any traffic slow down is not to exceed five minutes or as approved by the Region Traffic Engineer and communicated through the Engineer.

3.8 TEMPORARY PORTABLE RUMBLE STRIPS (TPRS)

- A. Clean road surface with broom or blower to remove all gravel, sand, dust, or other debris.
- B. Assemble modular pieces into strips that match the width of the travel lane as closely as possible.
 - 1. Follow manufacturer's recommendations so that pieces are properly interlocked.
- C. Place TPRS perpendicular to traffic and centered in lane.
 - 1. Refer to project details for array placement, spacing, and signing requirements.
 - 2. Follow manufacturer's recommendations and TC series standard drawings for installation and product orientation.
 - 3. Do not glue, nail, or otherwise affix TPRS to the road surface.
- D. Place TPRS at the same time as other traffic control devices, prior to work taking place.
 - 1. Maintain the TPRS in proper condition, alignment, spacing, and location.
 - a. Set TPRS perpendicular to the travel lane.
 - 1) Adjust TPRS when any one rumble strip becomes skewed by a distance of 3 ft or more. Skew distance is the distance parallel to direction of travel between the ends of the strip.

- 2) Adjust the TPRS if the parallel distance between the individual rumble strips decreases by 5 ft or more.
 - 3) Temporary paint marks may be placed to give reference of original locations.
 - b. Make adjustments to TPRS as often as necessary during working hours, but at least during each traffic control inspection.
 - 1) Adjustments to TPRS must be made within 30 minutes of discovery or notification of misalignment.
 - c. Remove TPRS during non-working hours.
- E. Do not use TPRS during snow events, or at temperatures outside of the manufacturer's recommendations.

END OF SECTION

SECTION 01558

TEMPORARY PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for installation of temporary pavement markings.

1.2 RELATED SECTIONS

- A. Section 02765: Pavement Marking Paint
- B. Section 02842: Delineators
- C. Section 02890: Retroreflective Sheeting

1.3 REFERENCES

- A. ASTM D 4592: Preformed Retroreflective Pavement Marking Tape for Limited Service Life.
- B. Utah MUTCD

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data sheet and recommended installation instructions.

1.6 ACCEPTANCE

- A. Pavement marking paint and glass beads accepted according to Section 02765.

1.7 PAYMENT PROCEDURES

- A. Temporary Pavement Markings
 1. This work is considered incidental to other items of work and no separate measurement or payment will be made when there is no pay item.
 2. Include all costs in Traffic Control.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING PAINT AND GLASS BEADS

- A. Refer to Section 02765.
 - 1. Price reductions for wet mil thickness do not apply.

2.2 PAVEMENT MARKING TAPE

- A. Refer to ASTM D 4592, Type I (Removable).
- B. Minimum reflective values – Refer to ASTM D 4592.

2.3 TEMPORARY RAISED PAVEMENT MARKERS

- A. Provide plastic raised pavement markers that have reflective material with clear covers as needed for the particular application.
 - 1. Supply marker body manufactured of polyurethane plastic in color specified for required type.
 - a. Width 4 inches, height 2 inches, thickness 0.06 inches.
 - 2. Retroreflective sheeting to be at least 1 in² and according to Section 02890 for retroreflective sheeting requirements.
 - 3. Provide clear polyvinyl chloride covers attached to marker body with heavy duty staples.
 - 4. Supply marker with a method of attaching to pavement surface.
- B. Raised Pavement Marker Types
 - 1. Type Y1 – Yellow body with yellow reflective sheeting on both sides.
 - a. Optional – Type B1, black body with yellow reflective sheeting on both sides.
 - 2. Type W1 – White body with white reflective sheeting on both sides.
 - a. Optional – Type B2, black body with white reflective sheeting on both sides.

PART 3 EXECUTION

3.1 GENERAL

- A. Apply temporary pavement markings along the entire length of any roadway surfaces opened to traffic.
 - 1. Apply edge markings where delineation is removed or nonexistent.
 - a. Refer to Section 02842 and Utah MUTCD Section 3B.07.
 - 2. Use the same segment and cycle length of permanent markings for all temporary broken-line pavement markings.

- B. Use channelizing devices or other delineation as directed by the Engineer to indicate road user paths in work zones when it is not possible to provide a clear path with temporary pavement markings.

3.2 PAVEMENT MARKING PAINT AND GLASS BEADS

- A. Re-apply pavement marking paint at two week intervals to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.

3.3 PAVEMENT MARKING TAPE

- A. Apply pavement marking tape according to manufacturer's directions.
- B. Maintain or re-apply pavement marking tape to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.
- C. Inspect and replace immediately any loose, missing, or damaged pavement markings.
- D. Remove the tape immediately before paving.

3.4 TEMPORARY RAISED PAVEMENT MARKERS

- A. Attach raised pavement marker according to manufacturer's directions.
- B. Space raised pavement markers as follows:
 - 1. Solid line On 10 ft centers.
 - 2. Broken line Three on 5 ft centers spaced on a 40 ft cycle length.
- C. Inspect and replace immediately any loose, missing, or damaged markers.
- D. Remove markers immediately before paving.

END OF SECTION

SECTION 01571

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary environmental controls to control erosion and prevent sediment laden runoff from leaving the construction site and areas under the Contractor's control.

1.2 RELATED SECTIONS

- A. Section 02075: Geotextiles

1.3 REFERENCES

- A. AASHTO M 288: Geotextile Specifications for Highway Applications
- B. AASHTO Construction Stormwater Field Guide
- C. ASTM D 4355: Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- D. ASTM D 4491: Water Permeability of Geotextiles by Permittivity
- E. ASTM D 4751: Determining Apparent Opening Size of a Geotextile
- F. Utah Pollutant Discharge Elimination System, Utah Construction General Permit (UCGP)

1.4 DEFINITIONS

- A. Check Dam – A fiber roll or stone structure placed across a roadside ditch to temporarily protect ditch from channel erosion by slowing velocity of stormwater runoff and intercepting and trapping sediment.
- B. Disturbed Area – Areas within a construction site where existing vegetative cover, or existing stabilized areas, have been removed or altered and exposed soils are susceptible to increased erosion and sedimentation.

- C. Drop-Inlet Barrier – A barrier placed around a storm drain inlet grate, situated outside of roadway pavement condition, that is designed to intercept and trap sediment-laden runoff before entering the storm drain system.
- D. Fiber Roll – Wood excelsior, rice or wheat straw or coconut fibers rolled or bound netting to form a tube-like structure used to intercept and trap sediment.
- E. Final Stabilization – Procedures and controls completed as the final measure to protect disturbed areas of a construction site from erosion and sedimentation until vegetation regrowth occurs to provide ultimate erosion protection.
 - 1. Includes work within areas to be vegetated such as establishing final grades, placing topsoil, incorporating seed; roughening slopes by walking track-mounted equipment up and down slopes; applying mulch, erosion control blanket, flexible channel liner; and installing other landscape treatments to protect exposed soils from erosion.
 - 2. Includes work within areas intended to remain unvegetated such as placing final pavement; installing stone, gravel and other stable material that will prevent erosion of underlying soil.
- F. Gutter-Inlet Barrier – A device designed and prefabricated to secure to the top, envelop or hang below a storm drain inlet grate, situated within roadway pavement condition, that keeps sediment and debris from entering the storm drain system.
- G. Pipe-Inlet Barrier – A barrier placed at a pipe inlet that intercepts and traps sediment before entering the pipe.
- H. Sediment Trap – A small temporary excavated basin installed at low points on a construction site designed to trap sediment-laden runoff to allow sediment to settle out before leaving site.
- I. Silt Fence – A geotextile fabric fence used to intercept and trap sediment in a sheet flow situation, along the perimeter of a disturbed area.
- J. Slope Drain – A polyethylene pipe temporarily placed on a slope to collect and transport storm runoff down the face of a slope until permanent drainage facilities are installed or vegetation growth is adequate.
- K. Stabilized Construction Entrance – A layer of stone, underlined with a geotextile fabric, placed at a construction site entrance or exit used to reduce the amount of sediment or mud tracked onto adjacent paved roadways by vehicles leaving the construction site.

- L. Straw-Bale Barrier – Temporary barrier installed by placing straw bales end to end along perimeter of a disturbed area designed to intercept and slow sediment laden runoff before it leaves a construction site.
- M. Temporary Berm – A ridge of compacted soil with or without a shallow ditch that diverts stormwater runoff from a slope to a controlled release point.
- N. Temporary Environmental Fence – A high-visibility fence barrier used to delineate and prevent encroachment on sensitive areas.

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 TEMPORARY ENVIROMENTAL CONTROLS

- A. Fiber Roll
 - 1. Diameter (minimum weight per linear foot)
 - a. 18 inch (3 lb per linear foot)
 - b. 12 inch (2 lb per linear foot)
 - c. 9 inch (1 lb per linear foot)
 - 2. Functional Longevity – 24 months minimum (includes netting material).
 - 3. Matrix material – Wood excelsior, rice or wheat straw, and coconut fibers (coir) or in combination.
 - a) Material must be weed free.
 - 4. Netting – UV stabilized synthetic or coir material, with 1 inch maximum opening size, secured at end for matrix containment.
 - 5. Wood Stakes
 - a. 18 inch Fiber Roll – $\frac{3}{4}$ inches and 1½ inches by 3 feet minimum dimensions.
 - b. 12 inch Fiber Roll – $\frac{3}{4}$ inches and 1½ inches by 18 inch minimum dimensions.
 - c. 9 inch Fiber Roll – $\frac{3}{4}$ inches and 1½ inches 18 inch minimum dimensions.
- B. Silt Fence. Refer to EN Series Standard Drawings.
 - 1. Silt Fence Fabric – 3 foot minimum width, conforming to Table 7 of AASHTO M 288.
 - 2. Wood Post – 1½ inches by 1½ inches by 4 feet minimum dimensions.

3. Fasteners – Staples, wire, cable ties, or nails sufficient to maintain fabric attachment to post.
- C. Check Dam. Refer to EN Series Standard Drawings
1. Fiber Roll – 12 inch diameter, or
 2. Stone – Angular, well-graded 2 to 6 inch diameter.
- D. Drop-Inlet Barrier. Refer to EN Series Standard Drawings
1. Fiber Roll – 18 inch diameter, or
 2. Silt Fence
 - a. Wooden Support Frame – 2 by 4 inch (nominal) wood studs.
- E. Gutter-Inlet Barrier
1. Apparent Opening Size (ASTM D 4751) – between 20 and 40 sieve.
 2. UV Resistance (ASTM D 4355) – 65percent minimum.
 3. Flow Rate (ASTM D 4491) – 100 gpm/ft² minimum.
 4. Filter Material – Monofilament, woven or nonwoven geotextile.
 5. Provide protection to entire inlet opening.
 6. Types:
 - a. Above Inlet Gate
 - 1) Mount securely to the top side of the inlet grate at each corner with cable ties, wire or similar.
 - b. Inlet Cover Gate
 - 1) Sewn geotextile fabric that envelopes entire inlet grate.
 - 2) Must have built-in lifting straps or other device to allow removal of inlet grate and barrier.
 - c. Below Inlet Gate
 - 1) Mount device securely to the inlet grate or have independent frame that allows geotextile bag to hang below grate to capture runoff.
 - 2) Must be designed with a bypass feature that allows stormwater to be conveyed into the conveyance system when geotextile is filled to capacity.
 - 3) Must be able to remove from storm drain inlet and maintain device without dumping captured sediment into the storm drain system.
- F. Pipe-Inlet Barrier. Refer to EN Series Standard Drawings.
1. Fiber Roll – 18 inch diameter, or
 2. Stone – Angular, well-graded 2 to 6 inch diameter.

- G. Temporary Berm. Refer to EN Series Standard Drawings.
 - 1. Compacted existing soil.
 - 2. Free of debris, such as trees, brush, obstructions and other objectionable material that will not allow for compaction of berm material.
- H. Temporary Environmental Fence
 - 1. Fence Fabric
 - a. Polyethylene, high-density (HDPE) and UV stabilized
 - b. Height – 4 ft minimum
 - c. Color – Orange
 - 2. Posts
 - a. Wood Post – 1½ inches by 1½ inches by 4 feet minimum dimensions.
 - b. Fasteners – Staples, wire, cable ties or nails sufficient to maintain fabric attachment to post.
- I. Sediment Trap. Refer to EN Series Standard Drawings.
 - 1. Stone – Angular, well-graded 6 to 12 inch diameter
- J. Slope Drain. Refer to EN Series Standard Drawings.
 - 1. 12 inch diameter single wall polyethylene pipe
 - 2. Polyethylene pipe end section
 - 3. Stone – Angular, well-graded 6 to 12 inch diameter
 - 4. Wood Stakes – 1½ inches by 1½ inches by 3 feet minimum dimensions.
- K. Stabilized Construction Entrance. Refer to EN Series Standard Drawings.
 - 1. Stone – Crushed aggregate, well-graded 2 to 3 inch diameter.
 - 2. Geotextile Fabric (Separation) – Refer to Section 02075.
- L. Straw-Bale Barrier. Refer to EN Series Standard Drawings.
 - 1. Straw Bales – Certified weed free straw bales by the Utah Department of Agriculture.
 - 2. Wood Stakes – 1½ inches by 1½ inches by 4 feet minimum dimensions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install appropriate controls as shown before beginning earth disturbing activities.

- B. Refer to installation procedures outlined in EN Series Standard Drawings and the AASHTO Construction Stormwater Field Guide.
- C. Install temporary environmental fence in the required locations before construction activities begin.
 - 1. Install posts at a 12 ft maximum spacing so the fence does not sag more than 2 inches between posts.
 - 2. Weave the fence over the support posts alternating every two loops and secure it to the posts with fasteners.
- D. Install Gutter-Inlet Barrier according to manufacturer's recommendations.

3.2 INSPECTION

- A. Check installed controls before and after each rain event to verify proper working function and compliance with the UCGP.
- B. Replace controls that are not properly working to prevent erosion and sedimentation.

3.3 MAINTENANCE

- A. Maintain controls to function properly until surrounding disturbed areas have met final stabilization measures.
- B. Remove accumulated sediments from controls when depth reaches 50 percent of the control height or when it interferes with the performance of the control.
- C. Properly dispose of accumulated sediment.

3.4 REMOVAL

- A. Remove temporary environmental controls when surrounding disturbed areas have met final stabilization measures, except as follows:
 - 1. Do not remove perimeter controls, such as silt fence, fiber rolls or straw bales, when they protect a wetland or waterway unless the surrounding area meets final stabilization requirements identified within the UCGP.
 - 2. When the Engineer determines that controls should remain in place.
- B. Remove temporary environmental fence and posts upon completion of construction.

END OF SECTION

SECTION 01572

DUST CONTROL AND WATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide and apply water for dust control and pre-wetting, mixing, or compacting materials.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PAYMENT

- A. All costs associated with Dust Control and Watering are incidental to other items of work and no separate measurement or payment will be made unless otherwise specified.

PART 2 PRODUCTS

2.1 WATER

- A. Free of dirt, silt, and other detrimental matter in adequate quantities for dust control and watering requirements.

2.2 EQUIPMENT

- A. Water distribution system – Self-propelled, pressure distributor with a spray system, equipped with a positive shut-off control.
 - 1. Pressure pump must have the capacity to apply the whole load uniformly.
- B. Water truck – 1,000 U.S. gallons minimum capacity, with the capacity clearly and permanently marked on the tank.
 - 1. Engineer may require Contractor to verify capacity.

PART 3 EXECUTION

3.1 APPLICATION

- A. Apply water for dust control in quantities and locations as directed by the Engineer and to maintain environmental compliance.
 - 1. Dust control may be required at any time.
 - 2. Do not waste water.

END OF SECTION

SECTION 01721

SURVEY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction surveying, staking, measurement, and calculations essential to complete the project and properly control the entire work.
- B. Directed surveying.
- C. Processes and procedures for implementing Machine Control Guidance (MCG) technology. MCG uses Global Positioning System (GPS) and Robotic Total Station (RTS) in conjunction with three-dimensional computer models to determine the precise location and elevation of the materials being moved.

1.2 RELATED SECTIONS

- A. Section 02765: Pavement Marking Paint

1.3 REFERENCES

- A. UDOT CADD Standards
- B. UDOT Plan Sheet Development Standards
- C. UDOT Survey & Geomatics Standards Manual
- D. Utah Administrative Code
- E. Utah Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submittals must be signed and sealed by a Professional Land Surveyor licensed in the State of Utah.

- B. Statement before work begins indicating Department provided horizontal and vertical survey control has been field checked and the control has been determined to be accurate within the tolerances specified in the UDOT Survey and Geomatics Standards Manual. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
1. Attach field survey information used to verify control.
 2. Contact the Engineer verbally and in writing if discrepancies are found.
 3. Include additional survey points required to implement the MCG/RTS technology.
- C. Written description of the equipment before beginning work including calibration certifications, manpower, methods, and data storage format proposed for use to complete survey activities.
- D. Surveying and design data:
1. As-built survey and design data to the Engineer after project completion with compliance to the UDOT Survey and Geomatics Standards, Plan Sheet Development Standards, and UDOT CADD Standards. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 2. Complete the following if design plans were included with the advertising package for the project:
 - a. Provide a red-lined hard copy plan set showing "As-built" features denoting changes from the original design.
 - b. Provide an electronic copy of the red-lined 11 x 17 "As-built" plan, containing the "As-Built" stamp dated and signed by the Engineer (Utah Code 58-22-602), in a colored PDF format as follows:
 - 1) Resolution of not less than 400 dpi.
 - 2) Individual file sizes not greater than 100 megabytes.
 - 3) Group similar sheet types together into individual PDF files such as Summary Sheets grouped together in a single PDF file or Summary Sheets and Plan and Profile Sheets grouped together in a single PDF file.
 3. Complete the following if the Department provides 3D elements, 3D models, or both at advertising:
 - a. As-Built files and final model denoting design changes from the original design named and placed in accordance to the UDOT CADD Standards Manual, Plan Sheet Development Standards, and submitted into the UDOT Projectwise System.
 - b. Intermediate models at request of the Engineer.
 - c. Support paperless inspection when plan sheets are not provided.

- d. Documentation of quality control measurements.
 - e. As-Built model with approval of the Engineer to document design changes if construction of a project was based on a model prepared by the Contractor or a project that was not designed using paperless methodology.
- E. Survey Monuments certified supplement
 - 1. Refer to this Section, Article 3.12, paragraph C3 for submittal of drawings and notes.
- F. Provide the following for MCG technology implementation:
 - 1. Notification that MCG will be used on the project at preconstruction meeting.
 - 2. Electronic or hand written stakeout/cut-fill reports or both for cross section stakes, according to this Section, Article 3.5.
 - a. Reports are not required when measurement of work is by "Plan Quantity" or Weight.

1.6 MEASUREMENT

- A. Directed Survey – Use a survey crew measured by the hour and approved if extra survey work is directed. Department makes no additional payment for travel time to and from the project.

1.7 PAYMENT

- A. Directed survey work is paid for in the accepted quantities if needed and approved at a standard negotiated rate.

1.8 QUALITY ASSURANCE

- A. Assume responsibility for survey and control of the work and for correcting errors whether the errors are discovered during the actual survey work or in subsequent phases of the project and bears cost overruns resulting from errors.
- B. Any 3D model used in conjunction with MCG must be verified and approved before use by the Contractor.
- C. Assume responsibility for construction errors that result from the 3-D model once the design 3D model has been accepted.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Tools, supplies, and stakes suitable for use in highway survey work.
- B. Stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings.
- C. Survey instruments and supporting equipment capable of achieving the specified tolerances.
 - 1. Calibrate survey equipment annually and check for accuracy before beginning survey work and as required throughout the duration of the project. Make the calibration certificate available upon the Engineers request.

2.2 EQUIPMENT FOR DEPARTMENT USE

- A. Provide and maintain the following equipment when MCG is used on the project:
 - 1. GPS Capable Rover compatible with the other GPS equipment being used on the project.
 - 2. Other hardware and software associated with the equipment so that Department personnel can operate the equipment for quality assurance purposes.
 - 3. Provide adequate training so that Department personnel can operate the survey equipment.
 - 4. Make GPS rover available immediately upon request from the Engineer.
 - 5. Develop a process with the Department to check-in and check-out equipment from the Contractor.

PART 3 EXECUTION

3.1 PREPARATION

- A. Discuss and coordinate the following with the Engineer before survey work begins:
 - 1. Submittals
 - 2. Survey and staking methods
 - 3. Stake markings
 - 4. Grade control
 - 5. Referencing
 - 6. Structure control

7. Other procedures and control necessary for the work
 8. Documentation procedures
- B. Establish construction survey points, elevations, and grades as necessary to control layout and complete the work.
1. Verify control surveying and staking meet specified tolerances before beginning work.
- C. Calculate grades, elevations, offsets, and alignment data necessary for staking or setting items of work.
- D. The Department will provide, if available:
1. Horizontal and vertical control points and elevation benchmarks.
 - a. Do not disturb control points and elevation benchmarks.
 2. Cross sections developed during design, if any
 3. Electronic project data
 4. Digital Terrain Model used for design
 5. 3-D data consisting of:
 - a. LandXML files for the Design Digital Terrain Models, including features for projects implementing MCG
 - b. LandXML files for the Design Alignments
 - c. Bentley iModel may be substituted for LandXML data.
 - d. Bentley 3-D .dgn line work files.
- E. Record keeping – Keep field notes, diaries, and books according to standard surveying practice.
1. Make available survey records including field notebooks and forms used for the work to the Engineer upon request.
 2. Electronic records and reports are acceptable
- F. Contract Provision Disclaimer
1. Provide a written request to the Engineer to obtain electronic data.
 - a. Electronic data is available in UDOT standard CADD formats only.
 - b. Waive claims that may result from the use of or reliance on the electronic data.
 2. Electronic Data is prepared by the Department for its own purposes and not for the benefit of private individuals or businesses.
 3. Indemnify and hold the Department harmless for damages, costs, attorney fees, or other liabilities that might be incurred as a result of the Department's use and reliance on the Contractor's modified data.

3.2 DIRECTED SURVEY

- A. Conduct directed surveying if directed by the Engineer.
 - 1. Includes work needed for changes and extra work.
 - 2. Provide labor, materials, and equipment including total stations, global positioning system (GPS), LiDAR scanning or other equipment.

3.3 COMPUTATIONS AND PLOTS

- A. Use cross-sections to calculate volume measurements.
 - 1. Superimpose final cross sections with original cross sections and calculate final quantities using the average end area method.
 - 2. Develop cross-sections from field measurements.
 - a. Take cross section measurements both before and after excavation and before backfill.
 - b. Take cross sections at a maximum centerline spacing of 15ft when the centerline curve radius is less than or equal to 500 ft.
 - c. Take cross sections at a maximum spacing of 30 ft when the centerline curve radius is greater than 500 ft.
 - d. Take additional cross sections at breaks in terrain and at changes in typical sections.
 - e. Measure and record points at breaks in terrain for each cross section but at least every 15 ft.
 - f. Measure and record points to at least the anticipated slopes and reference locations.
 - g. Reduce cross section distances to horizontal distances from centerline.
 - h. Take cross sections at right angles to tangents and normal to curves.
 - i. Include in cross sections: grades, locations, and existing ground line profiles.
 - 3. May develop volumes from digital terrain models if:
 - a. Ground survey locations do not exceed 50 ft in any direction.
 - b. Major horizontal and vertical breaks in terrain are also included.
 - c. Horizontal and vertical control for the project is used.
 - d. DTM is verified accurate to required tolerances as indicated in the UDOT Survey & Geomatics Standards manual by spot checking throughout the length of the project. Refer to <http://www.udot.utah.gov/go/standardsreferences> to view this manual.

3.4 STAKE MAINTENANCE AND MARKINGS

- A. Provide and maintain reference/location stakes that identify stationing at least every 100 ft until the work has reached physical completion and accepted by the Engineer for each alignment and approved for removal.
 - 1. Provide reference/location stakes at whole station intervals such as 1032+00.
- B. Maintain staking necessary for the work until the construction has reached physical completion, accepted by the Engineer, and approved for removal.
 - 1. Legibly mark survey stakes with station and offset referenced to their respective control line.
 - 2. Mark slope, reference, and guard stakes with station.
 - 3. Renew illegible or damaged stakes.

3.5 SURVEY TOLERANCES

- A. Follow the guidelines set in the UDOT Survey & Geomatics Standards manual.
 - 1. Refer to <http://www.udot.utah.gov/go/standardsreferences> to view this manual.
- B. Amend the survey control diagram as requested for the project.
 - 1. Have the amended diagram sealed, signed, and dated by a Professional Land Surveyor in accordance with UC 58-22-601, 602, 603, and Utah Administrative Code R156-22-601.
 - 2. Refer to <http://www.udot.utah.gov/go/standardsreferences> for Utah Code and Utah Administrative Code.
- C. Relocate initial horizontal and vertical survey control points in conflict with construction to areas that will not be disturbed by construction operations.
 - 1. Furnish to the Region Surveyor in coordination with the Engineer the coordinates and elevations for the relocated points before the initial points are disturbed.
- D. Protect benchmarks from construction activities.
 - 1. Position benchmarks to allow a level rod to stand vertically and squarely on the mark.
- E. Reference benchmarks to centerline and horizontal measurements.
 - 1. Compensate or correct for systematic errors, including those associated with instrument calibration
 - 2. Select the appropriate equipment and methods, and use trained personnel.

3. Use appropriate error propagation and other measurement design theory to select the proper instruments, field procedures, geometric layouts and computational procedures to control random errors.
- F. Apply appropriate procedures to verify that the allowable positional tolerance of such points is not exceeded if radial survey methods, GPS, or other acceptable technologies or procedures are used to locate or establish points on the survey.
 - G. The positional tolerance may be tested by:
 1. Comparing the relative location of points in a survey as measured by an independent survey of equal or higher accuracy or,
 2. The results of a minimally constrained, correctly weighted least squares adjustment of the points on the survey.
 - H. Employ field procedures, instrumentation and adequate survey personnel in order to achieve a precision of 0.02 feet (or 6 mm) + 20 ppm.
 1. See Table 1 for construction staking tolerances.

Table 1

CONSTRUCTION STAKING TOLERANCES		
Description	Horizontal	Vertical
	Decimals of a foot	
Box Culverts	± 0.02	± 0.02
Bridge Superstructures	± 0.02	± 0.02
Bridge Substructures	± 0.02	± 0.02
Clearing and Grubbing Stakes	± 1.00	-----
Construction Centerline Control	± 0.05	-----
Construction Centerline Station	± 0.10	-----
Curbs, Walks, and Bike Paths	± 0.03	± 0.02
Grade Stakes – Roadway Subgrade	± 0.20	± 0.05
Grade Stakes – Top of Rock	± 0.20	± 0.03
Grade Stakes – Roadway Finish	± 0.10	± 0.02
Luminaire and Signal Poles (incl.	± 0.20	± 0.20
Manholes, Inlets, and Culverts	± 0.10	± 0.03
PCC Pavement	± 0.10	± 0.02
Slope Stakes and References	± 0.30	± 0.10
Traffic Markings	± 0.20	-----
Walls – Retaining, MSE, Sound, etc.	± 0.05	± 0.05
Wetland Mitigation Control Stakes	± 0.20	± 0.20

Notes:

1. Stakes for miscellaneous items not listed above will have a horizontal and vertical tolerance of 0.20 ft, unless otherwise directed.
2. Features that are to be constructed flush to another surface should take on the same tolerance as that surface.
3. Staking tolerances for special circumstances will be discussed at the pre-survey meeting.
4. Meet the appropriate construction tolerances for the material as specified in the special provisions or standard specifications, regardless of the construction staking tolerances, specific to the work item.
5. Use bridge control once established, independent of other project controls for the duration of the bridge construction. Refer to Survey & Geomatics Standards manual for bridge control methodology. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
6. Tolerances stated for each type of construction stake in this table indicates the acceptable deviation of the position of each reference point from its computed position relative to the given alignment and grade. Staked positions are generally checked using electronic stakeout reports and, if within tolerances, the stated position is accepted. Reference points may also have an accuracy relative to each other for precise measurements such as structures.

2. Survey Staking Methods:
 - a. Furnish reference stakes for slope stakes and stakes used for setting items for work.
 - b. Furnish the following for projects using Conventional Survey Methods:
 - 1) Establish and set slope stakes and references on both sides of centerline at cross section locations.
 - a) Place slope stakes at a maximum centerline spacing of 25 ft when the centerline curve radius is less than or equal to 500 ft.
 - b) Place slope stakes at a maximum spacing of 50 ft when the centerline curve radius is greater than 500 ft.
 - c) Place reference stakes at a maximum centerline spacing of 100 ft on tangents.
 - 2) Establish slope stakes in the field as the actual point of intersections of the design slope with the natural ground line.
 - 3) Set slope stake references outside the clearing limits.
 - 4) Include reference point and slope stake information on the reference stakes.
3. Furnish the following for projects using Machine Control Guidance Methods:
 - a. Establish and set location stakes and references on one side of centerline at cross section locations.
 - 1) Place cross section stakes at a maximum spacing of 300 ft. (Cross-section stakes reference physical points in the proposed cross-section, such as edge of pavement or top back of curb)
 - b. Place slope stakes at a maximum spacing of 300 ft.
 - c. Establish slope stakes in the field at the actual point of intersections of the design slope with the natural ground line.
 - d. Set slope stake references outside the clearing limits.
 - e. Include reference point information on the reference stakes.
 - f. Provide adequate bench marks throughout the project for construction equipment equipped with MCG to check setup and tolerances.
 - 1) Perform equipment checks at least once per day.
 - 2) Record equipment checks in a log for verification by the Engineer.
4. Staking limits – Reference/Location stakes can serve the purpose of the following staking requirements as long as required information for both purposes can be written on the stake.
 - a. Stake clearing limits on both sides of centerline at each established station.

- 1) Locate the clearing limit on the ground as shown by the cut and fill limits on the plans.
 - b. Stake right of way limits, or temporary construction easement (TCE) if one exists, every 500 ft maximum on tangents, every 250 ft maximum on curves where ROW is not delineated by existing fence lines or other obvious boundaries.
 - 1) Stake Right of Way limits at right of way break/angle points along the right of way lines.
 - 2) Reduce the distance if staking distance is affected by line of sight.
 - c. Stake environmental control limits on both sides of centerline at each established station.
 - 1) Locate the environmental control limits on the ground as shown by the slope rounding contours and environmental and silt fence locations as shown on the Plans.
 - 2) Stake environmental control limits every 25 ft in environmentally sensitive areas.
 - 3) Provide staking as needed to guarantee the silt fence is located inside of right of way in standard silt fence installations where stations/locations are not called out on the environmental control plan sheets,.
- I. Setting grade finishing stakes (Conventional Survey or RTK):
 1. Grade elevations and horizontal alignment:
 - a. On centerline.
 - b. On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 25 ft.
 - c. At the top of subgrade and the top of each aggregate course.
 2. Locations:
 - a. Set stakes on centerline, on each normal shoulder, and on the shoulder of the turnout where turnouts are constructed.
 - b. Set hubs at the center and along the edges of parking areas.
 - c. Set stakes in ditches to be paved.
 3. Maximum spacing between stakes along the alignment is 50 ft.
 4. Use brushes or guard stakes at each grade finishing stake.
 5. Reset grade finishing stakes as many times as necessary to construct the subgrade and each aggregate course.
- J. Grade Verification (Machine Control Guidance)
 1. The following procedure will only be applicable for verification of roadway layers for grade elevations and horizontal alignment.

- a. The Department will use the Contractor provided survey equipment that is capable of verifying grade to tolerances required.
 - b. The Department will verify elevations at the following locations:
 - 1) On centerline.
 - 2) On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 25 ft.
 - 3) At the top of subgrade and the top of each aggregate course.
- 2. Locations:
 - a. On centerline, on each normal shoulder, and on the shoulder of the turnout where turnouts are constructed.
 - b. At the center and along the edges of parking areas.
 - c. At the top of subgrade and the top of each aggregate course.
 - d. In ditches to be paved.
- 3. The Department will verify and document elevations at a 300 ft maximum spacing between locations along the alignment.
 - a. The Department reserves the right to increase the spacing between grade verification locations up to, but not to exceed, 1000 ft if a level of confidence can be attained by the Engineer.

3.6 CONCRETE PAVING

- A. Develop a method of horizontal and vertical survey control for the placement of concrete pavement.
 - 1. Use laser, wire, or string line to maintain horizontal and vertical control.
 - 2. Maximum spacing, 50 ft
 - 3. Set control on both sides of roadway.
- B. 3D Paving, Machine Control Guidance, Wireless Paver
 - 1. Stagger survey control on either side of the highway to provide a good strength of figure.
 - a. Place control points for MCG according to equipment manufacturer recommendations.
 - b. The instrument setup must obtain vertical accuracies within ± 0.02 ft of the existing control.
- C. Stake concrete joint and station stamp locations as determined by the Engineer.

3.7 DRAINAGE STRUCTURES

- A. Stake drainage structures in coordination with the Engineer.
 - 1. Survey and record the ground profile along the centerline of the structure.
 - 2. Determine the slope catch points at inlets and outlets.
 - 3. Set reference points and record information necessary to determine structure length and end treatments.
 - 4. Stake ditches or grade to make the structure functional.
 - 5. Plot the profile along centerline of the structure to show the natural ground, the flow line, the roadway section, and the structure.
 - 6. Mark guard stakes with the following, when applicable:
 - a. Diameter, length, and type of culvert such as 18 inch x 35 ft corrugated metal pipe (cmp)
 - b. The vertical and horizontal distance from the hub to the invert at the end of the culvert or intermediate point as needed or directed
 - c. Flow line grade of the pipe
 - d. Station
 - 7. Provide a reference at a maximum spacing of 50 ft for storm sewers and waterlines. Reference inverts of pipe at manholes.

3.8 BRIDGES

- A. Based upon the Projects Primary Control points, set at least 4 horizontal and vertical survey control reference points to be used for surveying bridge substructure and superstructure components including but not limited to pile locations and cutoffs, line and grade for abutments, bents, beam seats, anchor bolts, and screed grades.
- B. Set intermediate slope stakes at bridge abutments to establish transitions.
 - 1. Place finish grade stakes on the centerline of abutment bearing and at the top of slope of bridge berms.
 - 2. Place finish grade stakes on each side at top, mid-point, or slope and toe of fill.

3.9 BOX CULVERTS

- A. Set horizontal and vertical control and reference points.
 - 1. Establish and reference the centerline, back of parapet or barrier, skew, and flow line elevations at inlet, outlet, and breaks.

3.10 CURB AND GUTTER

- A. Set curb and gutter staking at 25 ft intervals on tangent and 10 ft intervals on curve radii.
- B. Set line and grade for curb and gutter within 0.02 ft of the proposed or established grade line.

3.11 GUARDRAIL

- A. Stake guardrail vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curves.
- B. Obtain the Engineer's approval and field verification of staking before installation.

3.12 EXISTING SURVEY MONUMENTS

- A. Locate and reference private and public land survey monuments that may be destroyed by project construction activities before disturbing those existing monuments and under the direction of a Professional Land Surveyor licensed in the State of Utah.
- B. Complete referencing and reestablishing those existing monuments before project completion.
- C. Reference and reestablish the monuments created by the county surveyor.
 - 1. Notify the county surveyor at least 30 days before the destruction of monument.
 - 2. Coordinate the reestablishment of section corner and quarter corner monuments with the county surveyor.
 - 3. Prepare a corner record to be filed in the office of the County Surveyor's Office per Utah State Code 17-23-17.5 unless prepared by the County Surveyor's Office.
 - 4. Submit a certified supplement to the Survey Control Sheet with notes to the Engineer showing references to section corners and quarter corners.
- D. The Department pays for the additional work as directed survey if a monument is found during construction and must be reset.

3.13 RETAINING WALLS

- A. Set horizontal and vertical control and reference points based upon the projects primary and secondary control.
 - 1. Establish and reference the centerline offsets for the walls, radius points, and the beginning and ending wall locations as shown.
- B. Stake retaining wall vertical and horizontal control at no more than 25 ft on tangent sections and 10 ft on curved sections.

3.14 PAVEMENT MARKING

- A. Layout temporary and permanent pavement markings according to Section 02765.
 - 1. Place references for traffic striping no more than 150 ft apart on tangents and 50 ft on curves.

3.15 CLEANUP

- A. Remove and dispose of flagging, lath, stakes, and other staking material after the project has reached physical completion and the Engineer has approved removal.

3.16 UTILITIES

- A. Stake control lines as needed in cooperation with the utility companies so their facilities can be relocated to their proper final position.
- B. Stake crossings or potential points of conflict between facilities to give proper horizontal and vertical control for the relocation.
- C. Schedule this survey work with the utility companies to minimize delays and disruption of survey stakes.
- D. Replace disturbed stakes as necessary to facilitate the relocations.
- E. The Contractor is responsible for costs incurred to relocate utility more than once due to inaccurate or incomplete staking.
- F. Collect survey grade coordinate data for exposed, relocated, and new utilities during construction.
 - 1. Collect data in 1 ft intervals unless otherwise directed in the UDOT Survey & Geomatics Standards manual. Refer to <http://www.udot.utah.gov/go/standardsreferences>.

3.17 EXISTING MILEPOST SIGNS

- A. Locate existing milepost sign stations within the project limits.
 - 1. Contact the Engineer to determine locations where a milepost sign was placed at a point other than the actual mile point due to prior physical limitations such as driveways, intersections, or bridge parapets, in coordination with Highway Referencing Specialist of the Asset Management Division.
- B. Reestablish locations of milepost signs before project completion if construction activities required removal of existing milepost signs.
 - 1. Reset sign location at original station of existing sign.
 - a. Exceptions
 - 1) Prior physical limitations listed in this Section, Article 3.17, paragraph A were removed during construction and no longer prevent installation of a sign at the actual mile point.
 - 2) Roadside conditions or newly constructed physical limitations would prevent reestablishment of milepost sign within 3 ft of its original station.
 - b. Contact the Engineer to determine how to proceed in either of these special cases in coordination with the Highway Referencing Specialist.
 - 2. Establish an appropriate offset for each milepost sign to meet installation and clear zone requirements.
- C. Contact the Engineer to determine the preferred action for reestablishing the milepost signs where the alignment of the roadway was modified during construction to the extent that the new measured mile point locations of milepost signs were shifted more than 10 ft from their original location.

END OF SECTION

SECTION 01741
FINAL CLEANUP

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Final cleanup and restoration of all areas disturbed by construction.

1.2 RELATED SECTIONS

- A. Section 01455: Materials Quality Requirements

1.3 REFERENCES

- A. AASHTO Roadside Design Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PAYMENT PROCEDURES

- A. All costs associated with Final Cleanup are incidental to other items of work and no separate measurement or payment will be made.
- B. Clean up work directed by the Engineer outside the area disturbed by the Contractor will be paid as extra work.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 CLEANING PROCEDURES

- A. Do not damage the final pavement surface.
- B. Only use equipment with rubber tread on the final pavement surface.

- C. Clean and finish areas within the clear zone as follows:
 - 1. Remove protrusions or depressions greater than 3 inches within the clear zone such as rocks, boulders, ridges, and stumps.
 - 2. Remove trees and provide proper sight distance.
 - 3. Determine clear zone according to AASHTO Roadside Design Guide when not shown.
- D. Clean drainage facilities of debris and obstructions caused by construction.
 - 1. Dispose of material removed.
- E. Remove or cover with fine material from roadway excavation or borrow, large rocks or boulders on fill slopes with the following exception:
 - 1. Large rocks and boulders protruding from the final graded surface six inches or less, on slopes steeper than 3:1 or beyond the clear zone.
- F. Do not undercut the slope on cut slopes.
 - 1. Remove all overhanging rocks.
 - 2. Solid ledge rock or partially buried boulders 0.33 yd³ or more may be left in place on slopes steeper than 4:1 beyond the clear zone.
- G. Clean and finish areas within right-of-way limits as follows:
 - 1. Remove all dead trees and shrubs.
 - 2. Prune trees and shrubs as required.
 - 3. Trim and shape trees to provide horizontal sight distance and 20 ft vertical clearances above the roadway.
 - 4. Remove undesirable live trees, shrubs, and all fruit trees to a depth of 18 inches below natural ground.
 - 5. Dispose of trash and debris.
- H. Clean and finish areas within staging and office sites as follows:
 - 1. Clean up and finish as specified for finishing local material source sites including seeding and mulching. Refer to Section 01455.

END OF SECTION

SECTION 01891

MOVE SIGNS AND MAILBOX ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for moving or resetting signs and moving or reconstructing mailbox supports.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- B. ASTM A 513: Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 CONCRETE

- A. Refer to SN Series Standard Drawings.
- B. Use an air-entrained (AE) concrete mix. Refer to Section 03055.

2.2 MAILBOX MOUNTING HARDWARE

- A. Provide all material necessary to meet the GW Series Standard Drawings.
- B. Post – welded mechanical tubing. Refer to ASTM A 513.
- C. Galvanize all hardware. Refer to AASHTO M 232.

PART 3 EXECUTION

3.1 MOVE SIGN

- A. Maintain existing signs until construction requires removal.
 - 1. Coordinate with Engineer a minimum of 24 hours before removing any sign.
- B. Relocate existing signs as shown or as directed by the Engineer.
- C. Remove concrete from existing posts.
- D. Reset sign following SN Series Standard Drawings.
- E. Fill and compact the hole created by removing sign post.
 - 1. Compact to density of adjacent material.

3.2 MOVE MAILBOX

- A. Furnish and install new posts, shelf, and brace.
 - 1. Firmly attach boxes to the support.
- B. Install temporary posts and mailboxes if needed until permanent assemblies are installed.
 - 1. Remove when no longer needed.

END OF SECTION

SECTION 01892

RECONSTRUCT CATCH BASIN, MANHOLE, AND MISCELLANEOUS BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Lower and raise catch basin, manhole, and miscellaneous boxes such as meter, valve, and monument boxes to meet the grade of the adjacent surfaces.
 - 1. Applies to grade adjustments not greater than 1 ft.

1.2 RELATED SECTIONS

- A. Section 01721: Survey
- B. Section 02721: Untreated Base Course (UTBC)
- C. Section 03055: Portland Cement Concrete
- D. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

- A. AASHTO M 105: Gray Iron Castings
- B. AASHTO M 199: Precast Reinforced Concrete Manhole Sections

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit request to use alternative grade rings to the Engineer for review.
 - 1. Include manufacturer's product data sheets and installation instructions for alternative grade ring material.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(AE) – Refer to Section 03055.

2.2 REINFORCING STEEL

- A. Coated reinforcing steel. Refer to section 03211.

2.3 GRADE RINGS

- A. Gray iron
 - 1. Grade 30B or greater. Refer to AASHTO M 105.
- B. Precast concrete grade ring
 - 1. Refer to AASHTO M 199.
- C. Alternative grade ring material may be used when authorized.

2.4 UNTREATED BASE COURSE

- A. Refer to 02721.

PART 3 EXECUTION

3.1 RECONSTRUCT CATCH BASIN, MANHOLE, AND MISCELLANEOUS BOXES

- A. Lower impacted catch basin, manhole, and miscellaneous boxes prior to rotomilling.
- B. Remove concrete collar, walls, frame, grade ring, and riser as necessary to lower or raise the item.
- C. Protect all remaining features.
- D. Reconstruct catch basin and manhole to match the appropriate CB Series Standard Drawings.
- E. Set the top so that all corners are recessed up to $\frac{1}{4}$ inch lower than the finished surface unless otherwise shown.
- F. Provide a concrete collar extending at least 12 inches outside the frame or flange and to a depth equal to the pavement but not less than 8 inches.
- G. Reestablish damaged survey monuments.
 - 1. Refer to Section 01721

3.2 PAVEMENT REPAIR

- A. Place and compact untreated base course below the pavement structure.
- B. Place pavement to match the existing pavement surface.

END OF SECTION

SECTION 02056

EMBANKMENT, BORROW, AND BACKFILL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Embankment, backfill, and bridge approach embankments.

1.2 RELATED SECTIONS

- A. Section 03575: Flowable Fill

1.3 REFERENCES

- A. AASHTO M 145: Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
- B. AASHTO T 11: Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
- C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- D. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5 kg (5.5-lb) Rammer and a 305 mm (12 inch) Drop
- E. AASHTO T 180: Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 inch) Drop
- F. UDOT Materials Manual of Instruction
- G. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS

- A. Well-graded material – Material having an even distribution of different particle sizes. This even distribution of particles of different sizes results in a dense mass upon compaction.

1.5 SUBMITTALS

- A. Provide the following before delivering material to the project:
 - 1. Supplier and source of materials.
 - 2. Gradation analysis. Refer to AASHTO T 27 and T 11.

3. Soil classification when applicable. Refer to AASHTO M 145.
 4. Maximum Dry Density and Optimum Moisture Determination
 - a. Use AASHTO T 180 Method D for A-1 soils and AASHTO T 99 Method D for all other soils.
- B. Engineering proposal for alternate materials or trench configurations for drainage pipe bedding and pipe backfill as outlined in this Section, Article 2.8 C.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing is according to UDOT Minimum Sampling and Testing Requirements.
- B. Engineer reserves the right to select and test material from any location at the construction site.
 1. Establish the limits of nonconforming material sampled non-randomly and correct.
- C. Density Requirements – Acceptance is on a lot-by-lot basis.
- D. Remove nonconforming material and replace with acceptable material.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide materials free of contamination from chemical or petroleum products for embankment and backfill placements. Materials may include recycled Portland Cement Concrete.
 1. Do not include asphalt pavement materials.

2.2 MATERIALS

- A. Borrow
 1. Classifications A-1-a through A-4. Refer to AASHTO M 145.
- B. Granular Borrow
 1. Classification A-1-a. Refer to AASHTO M 145.
 2. Non-plastic, well-graded, 3 inch maximum.
- C. Granular Backfill Borrow
 1. Classification A-1-a. Refer to AASHTO M 145.
 2. Well-graded, 2 inch maximum.

- D. Free-Draining Granular Backfill
1. Meet the following gradation:

Table 1

Free Draining Granular Backfill Gradation	
Sieve Size	Percent Passing
1½ inch	90-100
1 inch	20-55
¾ inch	0-15
⅜ inch	0-5

- E. Embankment For Bridge
1. Classification A-1. Refer to AASHTO M 145.
 2. 3 inch maximum.

2.3 EMBANKMENT

- A. Borrow or suitable roadway excavation materials excluding organic, frozen, or contaminated soils.

2.4 DRAINAGE PIPE BEDDING AND BACKFILL

- A. Drainage Pipe Bedding and Drainage Pipe Backfill
1. Granular Backfill Borrow, Classification A-1. Refer to AASHTO M145.
 - a. Well-graded material.
 - b. Maximum aggregate size is 1½ inches for plastic pipe, 2 inches for all other pipes.
 2. Flowable fill. Refer to Section 03575.
 - a. Use only for drainage pipe backfill.
- B. Other materials or trench configurations for drainage pipe bedding and backfill may be used only upon approval of the Contractor's engineering proposal. Proposals using this option may include the use of native material or uniformly graded materials enclosed in an appropriate drainage geotextile. Any proposal must include all of the following:
1. Stamped drawings and specifications signed and sealed by a Professional Engineer licensed in the state of Utah.
 2. Evaluation of site specific conditions and surrounding soils, including potential for migration of fines.
 3. A structural evaluation of the pipe support system for the proposed pipe that includes the pipe structural capacity and the depth of fill.
 4. Complete bedding or backfill source information including gradation, soil classification, and laboratory testing reports.

PART 3 EXECUTION

3.1 GENERAL

- A. Complete clearing, grubbing, stripping, and stockpiling topsoil before placing material.
- B. Requirements when placing material during freezing or snowy conditions:
 - 1. Do not place embankment on frozen or snow-covered areas.
 - a. Remove snow and frozen material from embankments, foundations, and borrow areas and furnish embankment material that can be compacted to the specified density.
 - 1. Measure removed material and provide quantities to the Engineer.
 - 2. The Department does not pay for removed material, frozen embankment replacement, or replacement material for a working platform or foundation meeting specification requirements if unfrozen.
 - 2. Do not deliver or use frozen material.
- C. Use appropriate compaction equipment adjacent to pipes, abutments, back walls, approach slabs, wing walls, retaining walls, and other structures.
 - 1. Expand the width of the trench to accommodate necessary compaction equipment.
 - 2. Compact by hand areas where compaction equipment cannot compact the soil.
- D. Over-excavate unsuitable material as directed by the Engineer.
- E. Do not use unsuitable material for embankment or backfill placement.
- F. Density Requirements
 - 1. Borrow, Granular Borrow, Granular Backfill Borrow, Embankment for Bridge, and Drainage Pipe Bedding
 - a. Meet minimum density test average of 96 percent of maximum laboratory density with no single determination lower than 92 percent.
 - 1) Use AASHTO T 180 Method D for A-1 soils and AASHTO T 99 Method D for all other soils.
 - 2) Maintain appropriate moisture for compaction during processing.

2. Drainage Pipe Backfill
 - a. Meet minimum density test average of 92 percent maximum laboratory density with no single determination less than 90 percent.
 - 1) Use AASHTO T 180 Method D for A-1 soils.
 - 2) Maintain appropriate moisture for compaction during processing.
 - b. Meet the pavement section material density requirement for pipes that encroach into the pavement section or use flowable fill.
3. Meet 100 percent of the developed field density for material with more than 30 percent retained on the $\frac{3}{4}$ inch sieve.
 - a. The Department develops a field density compaction curve according to UDOT Materials Manual of Instruction Section 989.
4. Free-Draining Granular Backfill
 - a. Meet 100 percent of the developed field density.
 - 1) The Department develops a field density compaction curve according to UDOT Materials Manual of Instruction Section 989.

3.2 EMBANKMENT AND BORROW PLACEMENT

- A. Place roadway excavation or borrow or both in embankment section with the highest quality material in the top portion of the embankment.
- B. Scarify and compact the top 8 inches of the surface of the working platform or foundation to at least 90 percent of maximum laboratory density when the embankment height is 6 ft or less.
- C. Break and scarify all underlying concrete pavement surfaces so that pieces do not exceed 1 ft² before placing embankment over an existing concrete pavement surface that is outside the limits of removal or excavation shown.
 1. Remove other pavement surfaces that are not Portland Cement Concrete.
- D. Maintain Drainage
 1. Grade and maintain the roadway to ensure adequate drainage.
 2. Maintain drainage pipes and drainage ditches or provide temporary facilities when interrupting items such as irrigation systems, sewers, and under-drains.

- E. Place an initial layer to act as a working platform over soft, wet ground when approved by the Engineer.
 - 1. Density requirements do not apply to the working platform.
 - 2. Meet density requirements for embankment placed above the working platform.
- F. Do not place initial layer of embankment until Engineer inspects and accepts the working platform or foundation.
- G. Spread embankment materials uniformly in layers not exceeding 1 ft (uncompacted depth) and compact to the density requirements.
 - 1. Reduce the lift thickness or modify operations if tests show unsatisfactory density.
- H. Finish subgrade surface within ± 0.2 ft of line and grade.
- I. Do not use rock or broken concrete materials over 1 ft in any dimension.
- J. Distribute larger particles so space exists for placing and compacting embankment material.
- K. Do not place rocks larger than 4 inches or broken concrete within 1 ft of the subgrade surface.
- L. Do not use compacting equipment that causes shear failure in the embankment.

3.3 GRANULAR BORROW, GRANULAR BACKFILL BORROW, AND BACKFILL PLACEMENT

- A. Finish surface within ± 0.1 ft of line and grade.
- B. Compact material in maximum 6 inch layers (uncompacted depth) to the density requirement.
- C. Backfill for structures such as bridges, foundations, box culverts, drains, and other structures.
 - 1. Place Embankment unless otherwise shown.

3.4 DRAINAGE PIPE FOUNDATION, BEDDING, AND BACKFILL PLACEMENT

- A. Place in 6 inch layers (uncompacted depth) and compact to the density requirement.

- B. Place uniform layers of drainage pipe backfill on both sides of the pipe and compact to the density requirement before placing successive lifts.
- C. Fully compact the haunch areas.

3.5 EMBANKMENT FOR BRIDGE PLACEMENT

- A. Construct bridge approach embankments from the existing ground up with the specified material to the limits defined in this Section and according to DD Series Standard Drawings.
 - 1. Approach Embankments
 - a. Place embankment beneath the bridge except riprap or other described materials used for MSE walls.
 - b. Place embankment from the bridge abutment centerline station to a point measured at least 150 ft away from the abutment along the approach roadway centerline and on the inside of abutments.
 - c. Use the described material throughout the length of the walls where retaining walls are located beyond this delineation.
 - 2. Intersecting Roadway Embankments
 - a. Place embankment from approximate edge of approach roadway at least 60 ft along intersecting roadway centerline.
 - 3. Adjoining Embankments
 - a. Place embankment at least 10 ft outward from edge of approach roadway pavement when adjoining embankment is not an approach embankment.
- C. Do not place initial layer of embankment until foundation or working platform is verified by the Engineer.
- D. Spread embankment materials uniformly in layers not exceeding 1 ft (uncompacted depth) and compact to the specified density requirements before placing the next layer. Reduce the lift thickness if tests show unsatisfactory density.
- E. Finish surface within ± 0.2 ft of line and grade.

3.6 FREE-DRAINING GRANULAR BACKFILL PLACEMENT

- A. Compact material in 1 ft maximum layers to the density requirement.
- B. Finish surface within ± 0.2 ft of line and grade.

END OF SECTION

Embankment, Borrow, and Backfill
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SECTION 02075

GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Geotextiles

1.2 RELATED SECTIONS

- A. Section 01571: Temporary Environmental Controls

1.3 REFERENCES

- A. AASHTO M 288: Geotextile Specification for Highway Applications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheet and recommended installation instructions.

1.6 PACKAGING, SHIPPING, AND STORING

- A. Protect the geotextile from direct sunlight, chemicals, mud, dirt, and debris during shipment and storage.
- B. Labeling and Tagging
 1. Identify each package by a tag or label securely affixed to the outside of the roll on at least one end.
 2. Provide the following required information on the tag:
 - a. Name of the geotextile manufacturer
 - b. Brand name of the product, width, length, and package weight of geotextile

PART 2 PRODUCTS

2.1 SILT FENCE GEOTEXTILE

- A. Refer to Section 01571.

2.2 EROSION CONTROL GEOTEXTILE

- A. Conforming to AASHTO M 288.

2.3 DRAINAGE GEOTEXTILE

- A. Class 2 nonwoven drainage geotextile according to AASHTO M 288.

2.4 SEPARATION GEOTEXTILE

- A. Class I fabric according to AASHTO M 288 with Apparent Opening Size of 0.60 mm maximum average roll value.

2.5 STABILIZATION GEOTEXTILE

- A. Class I fabric according to AASHTO M 288 with Apparent Opening Size of 0.43 mm maximum average roll value.

2.6 WEED BARRIER GEOTEXTILE

- A. Woven, needle-punched, polypropylene, 5.0 oz, weed barrier geotextile designed for commercial use.

PART 3 EXECUTION

3.1 GENERAL

- A. Place geotextile on areas that are smooth and free of projections or depressions.
 - 1. Do not drag the geotextile across the subgrade.
 - 2. Roll geotextile out as smoothly as possible in the direction of vehicle travel.
- B. Do not operate construction equipment or traffic directly on geotextile.
- C. Cover the geotextile with indicated cover material as soon as possible when placed for construction.
 - 1. Do not leave uncovered for more than five days.
- D. Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted.
 - 1. Use at least a 6 inch thick cover layer or twice the maximum aggregate size, whichever is thicker.
 - 2. Do not end-dump cover material directly on the geotextile except as a starter course.

- E. Limit construction vehicles in size and mass so rutting in the initial layer above the geotextile is not more than 3 inches deep or half the layer thickness, whichever is less.
 - 1. Do not turn vehicles on the first layer.

3.2 INSTALL SILT FENCE GEOTEXTILE

- A. Refer to Section 01571.

3.3 INSTALL EROSION CONTROL GEOTEXTILE

- A. Install at locations shown.
- B. Overlap the geotextile at least 2 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified.
- C. Place overlapped geotextile so that the upstream sheet overlaps the downstream sheets.
- D. Overlap each sheet over the next downhill sheet for placement on slopes.
- E. Anchor the geotextile using key trenches or aprons at the crests and toes of the slope.
- F. Repair – Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.

3.4 INSTALL DRAINAGE GEOTEXTILE

- A. Install at locations shown.
- B. Place and secure geotextile to provide direct contact against the excavated surface.
- C. Overlap successive sheets of geotextile at least 1 ft in the down-gradient direction of flow.
- D. Overlap geotextile at least 1 ft at the top of the trench, where applicable.
- E. Place fill beginning with the sheets overlapped above subsequent sheets to hold geotextile in place.
- F. Repair – Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.

3.5 INSTALL SEPARATION GEOTEXTILE

- A. Install for pavement sections or other applications at locations shown.
- B. Overlap the geotextile at least 1 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified.
- C. Repair – Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.
- D. Place fill, beginning with the sheets overlapped, above subsequent sheets to hold geotextile in place.
- E. Use pins 18 inches long to help secure the geotextile during installation.

3.6 INSTALL STABILIZATION GEOTEXTILE

- A. Install stabilization geotextile at locations shown.
- B. Overlap the geotextile at least 2 ft at all longitudinal and transverse joints or sew the geotextile unless otherwise specified.
- C. Overlap each sheet over the next downhill sheet for placement on slopes.
- D. Repair – Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.
- E. Place fill to hold geotextile in place beginning with the sheets overlapped above subsequent sheets.
- F. Use pins 18 inches long to help secure the geotextile during installation.

3.7 INSTALL WEED BARRIER GEOTEXTILE

- A. Preparation
 - 1. Remove sharp objects, large stones, and undesirable vegetation.
 - 2. Cut an “X” over each plant and push geotextile under plant base if placing geotextile over an existing bed.
 - 3. Roll geotextile over soil and cut an “X” for each plant hole if placing over a new bed.
 - 4. Fold excess geotextile under and cover with specified landscaping materials.
- B. Surface Cover
 - 1. Provide at least 4 inches of cover on all areas on the geotextile.

2. Increase thickness of cover material over geotextile to three times the diameter of the largest rock material if using large landscape rock.
 3. Do not leave any portion of geotextile exposed to direct sunlight.
- C. Repair
1. Repair immediately if damaged.
 2. Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.
- D. Maintenance
1. Maintain surfaces and supply additional landscape materials where necessary including areas affected by erosion.

3.8 SEW

- A. Perform sewing as specified in AASHTO M 288, Appendix, Seaming.

END OF SECTION

SECTION 02078

ASPHALT PAVING FABRIC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for preparing asphalt pavement surface and installing asphalt paving fabric.

1.2 RELATED SECTIONS

- A. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

- A. AASHTO M 288: Geotextile Specification for Highway Applications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Test reports and Manufacturer's Certificate of Compliance for information with the shipment to the job site.

1.6 PACKAGING, SHIPPING, HANDLING, AND STORING

- A. Identify each roll by a tag or label securely fastened to the outside. List the following required information on the tag or label:
 - 1. Name of the fabric manufacturer
 - 2. Brand name of the product
 - 3. Width, length, and package weight of fabric

1.7 PROTECTION

- A. Protect the fabric from direct sunlight, chemicals, moisture, mud, dirt, and debris during shipment and storage.

PART 2 PRODUCTS

2.1 ASPHALT PAVING FABRIC

- A. Use needle-punched non-woven fabric constructed exclusively of manmade polymeric fibers resistant to rotting, mildew, insects, chemicals, and ultraviolet (UV) light.
 - 1. Refer to AASHTO M 288, Paving Fabric Requirements.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare Pavement Surface
 - 1. Remove all dirt, water, oil, and foreign materials.
 - 2. Clean out and fill cracks wider than ¼ inch with sand and asphalt emulsion filler material.
- B. Apply tack coat to the prepared surface at a rate of 0.25 to 0.30 gal/yd² as determined by the Engineer. Refer to Section 02748.
 - 1. Additional tack coat is required on overlapped areas.
 - 2. The Engineer determines the tack coat rates according to manufacturer recommendations and the following performance requirements:
 - a. Satisfy asphalt retention properties of fabric.
 - b. Bond the fabric and overlay to the underlying surface.
 - c. Do not create a slippage potential for the overlay.
 - 3. Uniformly spread excess tack coat before it cools.

3.2 INSTALL FABRIC

- A. Place fabric over tack coat with a mechanical unit that produces a wrinkle-free placement.
 - 1. Remove small wrinkles by hand brooming.
 - 2. Cut the fabric overlapping in the direction of paving for wrinkles in excess of 1 inch wide.
- B. Overlap transverse joints 6 inches in the direction of paving and bond with additional tack coat.
- C. Overlap longitudinal joints 4 inches and bond with additional tack coat.

END OF SECTION

SECTION 02082

WATER METER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water meter installation as shown.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES

- A. ASTM D 1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- B. American Water Works Association (AWWA) Standards

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 WATER METERS AND ACCESSORIES

- A. Refer to AWWA Standards.
- B. Meter Yoke – 21 inch high (minimum) copper setter as manufactured by Ford or equal.
- C. Meter Box
 - 1. Rigid PVC pipe meeting ASTM D 1784.
 - 2. 18 inch diameter by 3 ft long.
 - 3. Free standing crush factor of 3,000 lb.

- D. Meter Box Cover
 - 1. 12 inch minimum diameter lid with lock.
 - 2. 20 inch minimum diameter ring constructed of cast iron.
- E. Pipe and Fittings
 - 1. Type K copper for sizes 2 inch and smaller.
 - 2. Ductile iron class 51 for sizes larger than 2 inch.
- F. Aggregate
 - 1. Meet specifications for Free Draining Granular Backfill.
 - 2. Refer to Section 02056.
- G. Corporation Stop and Service Saddle Clamp
 - 1. Supplied by the water system authority.
- H. Joint Seal Tape (Teflon).

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate with the water system authority as described for the installation of items not performed by own forces.
- B. Before trenching:
 - 1. Stake water meter.
- C. Coordinate all water main shutdowns with the water system authority and notify the Engineer 72 hours before the shutdown.

3.2 INSTALL CONTRACTOR FURNISHED WATER METERS

- A. Install according to AWWA.
- B. Install water meter according to manufacturer's specifications.
 - 1. Place a 6 inch deep free draining granular backfill sump in the bottom of the meter box.
- C. Bed all pipe and surround the pipe with 2 inches of sand.
- D. Backfill and compact the trenches to the same density as the ground adjacent to the trench after bedding material is placed.

3.3 INSTALL FURNISHED WATER METERS AND RELOCATED WATER METERS

- A. Replace all existing water service lines with new pipe from the main supply line to the water meter unless otherwise described.
- B. Coordinate the relocation of existing water meters with the water system authority.
- C. Use existing water meter, yoke, box, and cover for relocated water meters. Furnish pipe and fittings as necessary.
- D. Complete work that is not completed by the water system authority.

END OF SECTION

SECTION 02221

REMOVE STRUCTURE AND OBSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal and disposal of structures and obstructions that interfere with construction.
- B. Salvage of equipment or materials when specified.

1.2 RELATED SECTIONS

- A. Section 00727: Control of Work
- B. Section 01355: Environmental Compliance
- C. Section 01721: Survey
- D. Section 02056: Embankment, Borrow, and Backfill
- E. Section 02705: Pavement Cutting
- F. Section 03055: Portland Cement Concrete
- G. Section 03374: Move Bridge
- H. Section 03575: Flowable Fill

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Copies of disposal permits, agreements, or both.
- B. Working Drawings
 - 1. Demolition Plan for review.
 - a. Required for existing bridge removal when removal operations will be performed over or adjacent to public traffic or railroad property, or when specified, shown, or requested by the Engineer.

- b. Show equipment, methods and sequence of removal.
- 2. Bridge Removal Plan for review.
 - a. Required when moving an existing bridge to a remote site for demolition or reuse.
 - b. Include the following:
 - 1) Working drawings for temporary bridge works according to Section 03374.
 - 2) Lifting, Transporting, and Setting Plan according to Section 03374.
 - 3) Move System Plan according to Section 03374.
 - c. Contract plan revisions to the existing bridge plans necessitated by the Contractor's construction methods are required when moving the existing bridge to a remote storage site for future reuse. Refer to Section 03374.

1.6 PROJECT SITE CONDITIONS

- A. Protect adjacent structures and utilities and their contents that are designated to remain.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Use Class A (AE) Concrete. Refer to Section 03055.

2.2 GRANULAR BORROW AND GRANULAR BACKFILL BORROW

- A. Refer to Section 02056.

2.3 FLOWABLE FILL

- A. Refer to Section 03575.

PART 3 EXECUTION

3.1 PREPARATION

- A. Review all work procedures with the Engineer.
- B. Coordinate utility location according to Section 00727.
 - 1. Locate and protect all active utilities.
 - 2. Before beginning work:
 - a. Notify Engineer

- b. Notify owners of affected utilities
 - c. Have the utilities in the area located by Blue Stakes
- C. Restore utility services disturbed by construction operations.
- D. Disconnect water service by excavating to the corporation stop and turning it off. Disconnect the service line from the corporation stop.
- E. Remove items such as existing cesspools and leach lines.
- F. Excavate all material necessary to permit removal..

3.2 BACKFILL AND COMPACTION

- A. Fill all holes or pits resulting from removal operations with suitable material.
- B. Compact the backfilled areas to the density of the surrounding ground or as specified.
- C. Department will pay separately for Roadway Excavation or Borrow material used for backfill.
 - 1. Material items not included in the Bidding Schedule are considered incidental to the work.

3.3 REMOVAL AND DISPOSAL

- A. Remove and dispose of material promptly using methods acceptable to the Engineer and according to applicable rules and regulations.
 - 1. Include excavation, removal, transportation, and disposal costs in the item of work.
- B. Remove concrete to at least 2 ft below the subgrade surface or finished ground lines.
- C. Dispose of removed obstructions at a site secured by the Contractor.
 - 1. Obtain required permits and provide an environmentally safe area for disposal of removed items. Refer to Section 01355.
- D. Removed materials not designated for use or salvage become the property of the Contractor unless owned and requested by a utility company.

3.4 SALVAGE

- A. Salvage designated equipment and materials.
- B. All other materials become the property of the Contractor unless otherwise noted.

3.5 REMOVE BUILDING, BASEMENT, AND FOUNDATION

- A. Move or demolish designated buildings including basements, foundations, sidewalks, pavement slabs, porches, fences, and outbuildings on each parcel.
- B. The Department is not responsible for vandalism or theft that occurs to the building or its contents that reduces the value of the salvage or increases the cost of removal after the award of the Contract.
- C. Break the floor into pieces not larger than 1 ft² in areas to remain in place. Remove and dispose of pieces over 1 ft².

3.6 REMOVE SEPTIC TANK AND UNDERGROUND TANK

- A. Empty and dispose of tank contents according to Section 01355.
- B. Break down and remove tank and appurtenances to at least 2 ft below the subgrade surface or finished ground lines.
- C. Break the floor into pieces not larger than 1 ft² in area.

3.7 REMOVE BURIED FUEL TANK

- A. Remove buried fuel storage tanks and dispose of tank contents according to all applicable Laws and Regulations.
- B. Do not spill fuel on subgrade.
- C. Comply with the State and local authorities having jurisdiction over fuel tank removals.

3.8 REMOVE BRIDGE AND BOX CULVERT

- A. Remove structure so that no remaining portion is closer than 3 ft to a watercourse or closer than 2 ft to the subgrade and embankment surface or within 2 ft of the finished ground lines.

- B. Remove structures that will interfere with proposed construction.
- C. Complete blasting or other removal operations of existing structure that may damage new construction before beginning the new work.

3.9 REMOVE CONCRETE HEADWALL

- A. Remove headwall where designated.

3.10 REMOVE CONCRETE SLOPE PROTECTION

- A. Remove portions of the existing slope protection and cutoff wall as shown.
- B. Mark the concrete slope protection removal limits in the presence of the Engineer.
- C. Saw cut the existing slope protection to full depth.
- D. Do not damage the portions of concrete slope protection that will remain.

3.11 REMOVE MANHOLE, CLEANOUT, DIVERSION BOX, AND CATCH BASIN

- A. Maintain satisfactory by-pass service during construction operations.
- B. Plug unused sewers with a 2 ft long concrete plug.

3.12 REMOVE PIPE AND PIPE END SECTION

- A. Remove pipe, end sections and attached appurtenances.
- B. Cut pipe to 2 ft inside the Department's right-of-way when the pipe extends into private property.
 - 1. Seal the remaining pipe with a 2 ft long concrete plug.
- C. Seal openings in remaining manhole or catch basin walls with a concrete plug.

3.13 ABANDON PIPE

- A. Completely fill the pipe with flowable fill.
 - 1. Obtain approval from the Engineer for alternate materials.

- B. Cut pipe to 2 ft inside the Department's right-of-way if the pipe extends into private property.
 - 1. Seal the pipe extending into private property with a 2 ft long concrete plug.
- C. Survey the location of exposed abandoned pipes ends. Refer to Section 01721.

3.14 REMOVE CONCRETE AND ASPHALT PAVEMENT

- A. Cut existing pavement on the designated lines with straight vertical edges free from irregularities when joining new construction to existing pavement. Refer to Section 02705.
- B. Completely remove pavement down to the underlying base course or subgrade.

3.15 REMOVE RAILROAD TRACK

- A. Remove all rails, ties, paving, track encasement, and other appurtenances to limits as shown.
- B. Leave crushed stone or gravel ballast.
 - 1. Grade as required.

3.16 OBLITERATE CONCRETE ROAD

- A. Break up pavement into pieces not larger than 1 ft² in area.
 - 1. Scarify and cover broken concrete with at least 1 ft of suitable backfill material.
- B. Fill depressions and form rounded slopes to blend with the natural or surrounding contours.
- C. Grade materials either along the toe of an embankment or into a depression or borrow pit.
 - 1. Cover with at least 1 ft of suitable backfill material.

3.17 REMOVE CONCRETE SIDEWALK AND CONCRETE DRIVEWAY

- A. Remove concrete to the nearest expansion joint or saw cut to provide proper grades and connections.
- B. Make concrete cuts straight, vertical to the surface, full depth, and free from irregularities. Refer to Section 02705.

3.18 REMOVE CONCRETE CURB, CONCRETE GUTTER, CONCRETE CURB AND GUTTER, RAISED ISLAND, AND BITUMINOUS CURB

- A. Remove concrete curb, concrete gutter, concrete curb and gutter, raised island, bituminous curb, and parts of such improvements to an existing joint or joint sawed with a vertical face.
- B. Remove material to provide proper grades and connections.

3.19 REMOVE CONCRETE BARRIER

- A. Precast
 - 1. Remove connection pins and concrete barrier including any stabilization pins.
 - 2. Dispose or salvage as required.
 - a. Contact the Engineer for delivery location and coordination for salvaged barrier.
- B. Cast-In-Place
 - 1. Saw cut the pavement at the front face of the cast-in-place barrier.
 - 2. Remove barrier and underlying pavement.

3.20 REMOVE GUARDRAIL

- A. Remove and dispose of guardrail, posts, hardware, anchor assemblies, terminal assemblies, and attached posts, signs, and delineators.
- B. Remove steel posts to at least 8 inches below the subgrade surface or finished ground lines.

3.21 REMOVE CATTLE GUARD

- A. Remove the cattle guard to at least 2 ft below the subgrade surface or finished ground lines.
- B. Prevent livestock from entering work site from adjacent properties during removal and installation.

3.22 REMOVE FENCE

- A. Prevent people or livestock from entering work site from adjacent properties during removal and installation.
- B. Remove fence, posts, and foundations to at least 2 ft below subgrade or finished ground lines.

- C. Do not damage vegetation and ground cover during removal operations.

3.23 REMOVE TREE

- A. Remove all trees with a circumference larger than 20 inches measured at a point 2 ft above existing ground.
 - 1. A tree consists of stump, root, trunk, branches, and foliage.
 - 2. Multiple leaders rising from a common root will not be counted separately.
 - 3. Remove the root system to at least 2 ft below the finished ground level and within a 2 ft radius of the stump.
- B. Trees removed with a circumference 20 inches or less measured at 2 ft above existing ground are considered incidental construction.

3.24 REMOVE UTILITY POLE

- A. Remove pole and all appurtenances.
- B. Remove foundation to at least 2 ft below subgrade or finished ground lines.

END OF SECTION

SECTION 02225

ASPHALT SURFACING REMOVAL (STRUCTURES)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of existing asphalt surfacing from bridge decks and approach slabs.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 REMOVAL EQUIPMENT

- A. Use equipment capable of removing the full depth of asphalt on the deck and the approach slabs without damaging the underlying concrete surfaces and bridge superstructure for full-depth removal.
- B. Use equipment capable of removing a uniform thickness of asphalt from the deck and the approach slabs without damaging the underlying asphalt, waterproofing membrane, and concrete surfaces for partial-depth removal.

PART 3 EXECUTION

3.1 FULL DEPTH REMOVAL

- A. Verify total asphalt depth before removal at the locations shown.
 - 1. Notify Engineer of any discrepancies between depth measured and the depth shown.
- B. Remove asphalt as shown.
- C. Remove existing waterproofing membrane from the deck and concrete approach slabs.

- D. Notify Engineer of damage to the deck or approach slab surface that occurs during the removal.
- E. Protect existing features to remain from damage.

3.2 PARTIAL DEPTH REMOVAL

- A. Refer to the plans for the asphalt surfacing removal depth.
- B. Verify total asphalt depth before removal at the locations shown.
 - 1. Notify Engineer of any discrepancies between depth measured and depth shown.
- C. Notify Engineer of damage to the existing waterproofing membrane on the deck and approach slabs that occurs during the removal.
- D. Allow no traffic on the asphalt surface after partial depth asphalt removal. Return traffic only after placing the final surfacing.
- E. Protect existing features to remain from damage.

3.3 ASPHALT DISPOSAL

- A. Asphalt surfacing material removed becomes the property of the Contractor, unless otherwise specified.
- B. Dispose of removed asphalt material.

END OF SECTION

SECTION 02231

SITE CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Clear, grub, remove, and dispose of trees, stumps, and debris within the designated limits of the roadways, channels, easements, and other designated areas.

1.2 RELATED SECTIONS

- A. Section 01355: Environmental Compliance
- B. Section 01571: Temporary Environmental Controls
- C. Section 02221: Remove Structure and Obstruction

1.3 REFERENCES Not Used

1.4 DEFINITIONS

- A. Clear – Remove and dispose of trees, stumps, logs, limbs, sticks, vegetation, debris, and other material on the natural ground surface.
- B. Grub – Remove and dispose of roots, buried logs, debris, organic matter, and other deleterious materials under the ground surface.

1.5 SUBMITTALS

- A. Copies of disposal permits, agreements, or both.

1.6 PAYMENT PROCEDURES

- A. Site Clearing and Grubbing when no bid item is included in the proposal:
 - 1. This work is considered incidental to other items of work and no separate measurement or payment will be made.
 - 2. Include all costs in other items of work.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify with the Engineer the vegetation or objects to be removed.
- B. Review work procedures with the Engineer.
- C. Schedule work carefully with consideration for property owners and general public.
- D. Refer to Section 01571 for temporary environmental measures.

3.2 VEGETATION REMOVAL

- A. Grub the areas 2 ft below natural ground, within the limits of clearing, of all stumps, roots, buried logs, and all other underground obstructions.
- B. Stumps, roots, and non-perishable solid objects may remain in cleared areas where the embankment is:
 - 1. 2 ft or more above the natural ground.
 - 2. At least 2 ft away outside the slope stake lines.
- C. Completely grub stumps and roots where a structure is to be constructed, piles are to be driven, or unsuitable material is to be removed.

3.3 BACKFILLING

- A. Backfill all stump holes, cuts, depressions, and other holes resulting from clearing and grubbing within areas to receive embankment.
 - 1. Compact backfilled areas to the density of the surrounding ground.
- B. Measure and pay separately for materials used for backfilling under Roadway Excavation or Borrow.
- C. Consider Roadway Excavation and Borrow as incidental to the work when these items are not included in the bid proposal.
 - 1. No separate measurement or payment made in this case.

3.4 DISPOSAL

- A. Dispose of material. Refer to Section 01355.
- B. Do not dispose of material within the designated roadbed.
- C. Outside of the Right-of-Way
 - 1. Acceptable when done according to prevailing laws including environmental laws, ordinances, regulations, and rules.
- D. Inside the Right-of-Way
 - 1. Bury material at locations specified by or acceptable to the Engineer.
 - 2. Use material to widen embankments and flatten embankment side slopes as approved by the Engineer.
 - 3. Cover disposed material with at least 2 ft of earth and grade to drain properly.
 - 4. Reduce wood to chips a maximum of ½ inch thick for mulching cut and fill slopes.
 - a. Chips may be buried or distributed uniformly on the ground surface and mixed with the underlying earth so the mixtures will not sustain burning.

3.5 TREE REMOVAL

- A. Refer to Section 02221.

3.6 PROTECTION

- A. Land monuments, property markers, or official datum points
 - 1. Protect until their removal is approved.
 - 2. Reference for re-establishment before removing.
- B. Protect trees from damage to roots and branches if they are designated to remain.
- C. Protect other vegetation and objects designated to remain.

END OF SECTION

SECTION 02316

ROADWAY EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation of all material within designated areas.
- B. Rock excavation and removal.
- C. Placement of excavated material in embankment and other areas.

1.2 RELATED SECTIONS

- A. Section 00725: Scope of Work
- B. Section 00820: Legal Relations and Responsibility to the Public
- C. Section 01355: Environmental Compliance
- D. Section 01571: Temporary Environmental Controls
- E. Section 01721: Survey
- F. Section 02056: Embankment, Borrow, and Backfill
- G. Section 02075: Geotextiles
- H. Section 02231: Site Clearing and Grubbing
- I. Section 02705: Pavement Cutting
- J. Section 02912: Topsoil

1.3 REFERENCES

- A. National Fire Protection Association (NFPA) Codes and Standards
- B. OSHA Construction Standards

1.4 DEFINITIONS

- A. Rock – Material that cannot be excavated and removed without blasting, chipping, cutting, or ripping.

1.5 SUBMITTALS

- A. Proposed method of blasting, delay pattern, explosive types, and type of blasting mat cover.
- B. Copies of disposal permits, agreements, or both.

1.6 ACCEPTANCE AND PAYMENT PROCEDURES

- A. Payment is plan quantity by the cubic yard.
 - 1. Make no adjustment to plan quantities if staked quantities differ by 5 percent or less.
- B. Notify the Engineer before beginning excavation in any area if the Contractor determines that the staked quantities differ from the plan quantities by more than 5 percent. The following procedures then apply:
 - 1. Provide calculations and plots according to Section 01721.
 - 2. Evaluate the “plan quantities” to “staked quantities” by individual cuts or balances as determined by the Engineer to provide the necessary accuracy.
 - 3. Do not begin excavation of any cut sections that the Contractor determines to differ from plan quantities by more than 5 percent until the calculations and plots have been submitted, reviewed, and approved by the Engineer.
 - a. No payments, partial or final, will be made until submissions are provided and approved.
- C. Approved quantities become the adjusted plan quantities and are paid at the original unit bid price when the Engineer determines the staked quantities differ from plan quantities by more than 5 percent.
- D. Payment includes excavation, removal, transportation, and disposal when existing pavement is included in Roadway Excavation plan quantity.

PART 2 PRODUCTS

2.1 MATERIALS FOR OVER-EXCAVATED AREAS

- A. Refer to Section 02056.

- B. Geotextile Fabric – Refer to Section 02075.

2.2 USE OF ON-SITE MATERIALS

- A. Refer to Section 00725.

2.3 EXPLOSIVES

- A. Use explosives, delay fuses, and all blasting materials as recommended by the explosives firm. Refer to NFPA 495 – Explosive Materials Code.

PART 3 EXECUTION

3.1 PREPARATION AND PROTECTION

- A. Refer to Sections 00820 and 01571.
- B. Locate and protect utilities as necessary.
- C. Clear and grub within the designated area before starting excavation. Refer to Section 02231.

3.2 BLASTING MATERIAL STORAGE

- A. Store all explosives securely in compliance with Laws and Regulations. Refer to Section 00820. Refer to NFPA 495: Explosive Materials Code.
- B. Mark all storage places clearly.

3.3 TOPSOIL

- A. Remove topsoil according to Section 02912.

3.4 DEWATERING

- A. Keep excavation free from surface and ground water through all stages of construction.
 - 1. Maintain adequate drainage during all stages of construction through pumping, pipe culverts, and drainage ditches.
 - 2. Provide temporary facilities when interrupting items such as irrigation systems, sewers, and under drainages.

3.5 EXCAVATION – STANDARD PROCEDURES

- A. Finish excavation to reasonably smooth and uniform surface.
- B. Provide and maintain satisfactory access to roads, streets, and adjacent property during all phases of construction according to the Traffic Control Plan.
- C. Remove material in all cut sections to the depth shown.
 - 1. Scarify to an 8 inch depth and compact subgrade to at least 90 percent of maximum laboratory density before placing pavement section.
- D. Excavate and waste unsuitable material.
- E. Material for backfilling or finishing
 - 1. Use suitable granular material encountered in excavation to construct the top layers of embankment, finishing the roadbed, or backfill when directed by the Engineer.
 - 2. Haul the granular material directly from excavation to the final position on the roadbed when practical.

3.6 ROCK REMOVAL – NONEXPLOSIVE METHOD

- A. Excavate solid rock 6 inches to 1 ft below subgrade and backfill with acceptable material.
 - 1. Rock removed more than 1 ft below subgrade will not be measured or paid for.
 - 2. Backfilling depth greater than 1 ft below subgrade will not be measured or paid for.

3.7 ROCK REMOVAL – EXPLOSIVE METHOD

- A. Comply with OSHA Construction Standards 1926 Subpart U - Blasting and the Use of Explosives.
- B. Comply with NFPA 495 – Explosive Materials Code.
- C. Provide a qualified explosives expert to act as an advisor and consultant during drilling and blasting operations.
- D. Do not blast beyond designated areas.

3.8 ROCK FACES

- A. Scale rock cuts of all loose rocks and fragments and leave in a neat and safe condition.

3.9 PAVEMENT

- A. Cut existing pavement on the designated lines with straight vertical edges free from irregularities when joining new construction to existing pavement. Refer to Section 02705.
- B. Excavate all pavement as shown.
- C. Dispose of pavement using methods acceptable to the Engineer according to all applicable rules and regulations and as follows:
 - 1. Inside the right-of-way as embankment, subject to the approval of the Engineer. Refer to Section 02056.
 - 2. Outside the right-of-way subject to the approval of the Engineer. Refer to Section 01355.

END OF SECTION

SECTION 02317

STRUCTURAL EXCAVATION AND BACKFILL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation for and backfilling of bridges, foundations, box culverts, pipe culverts, drains, and other structures.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES

- A. AASHTO LRFD Bridge Construction Specifications

1.4 DEFINITIONS

- A. Unsuitable material – Material not meeting specifications, organic materials, frozen lumps, soils such as peat or bog, and over-saturated silts, clays, or sands whose water content prevents appropriate compaction.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Drawings for Temporary Works.
 - a. Includes shoring, bracing, and cofferdams.

1.6 PAYMENT PROCEDURES

- A. Granular Backfill Borrow and Free Draining Granular Backfill are paid for separately when shown.

PART 2 PRODUCTS

2.1 BACKFILL FOR STRUCTURES

- A. Refer to Section 02056.

2.2 DRAINAGE PIPE BACKFILL

- A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

- A. Design and construct falsework and formwork according to AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
- B. Provide a cofferdam for underwater work.
 - 1. Remove all cofferdams, sheeting, and bracing when no longer needed.

3.2 EXCAVATION

- A. Structural excavation includes:
 - 1. Excavating foundations for structures.
 - 2. Control and removal of water.
 - a. Dewater the excavation if ground water is encountered.
 - b. Continue dewatering activities as necessary to prevent damage to the work.
 - 3. Installation and removal of facilities required to complete the work unless specified or allowed to remain in place.
- B. Excavate rock and other hard strata to elevations and dimensions shown.
 - 1. Clean and cut to a firm surface as shown.
 - a. Foundation cannot contain loose material.
 - 2. Clean out seams and fill with concrete, mortar, or grout.
- C. Do not over-excavate unless directed by the Engineer.
 - 1. Over-excavate and waste material unsuitable for the structure foundation to at least 1 ft below the design elevation
 - 2. Cost of over-excavation is paid as extra work when directed by the Engineer.
- D. Clean the space under structures, in channels, and adjacent areas affected by operations to prevent drift and scour.
- E. Dispose of all unused excavation material.

3.3 BACKFILL AND COMPACTION

- A. Backfill and compact excavated spaces not occupied by abutments, foundations, and other permanent work as described.
 - 1. Backfill to the surface of the surrounding ground, with a sufficient allowance for settlement.
 - 2. Bring backfill up uniformly on all sides of structures.

END OF SECTION

SECTION 02318
DITCH EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Small ditch and surface ditch excavation.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES Not Used

1.4 DEFINITIONS

- A. Small ditch – Ditch or channel, not V-shaped, with a bottom width less than 12.0 ft.
- B. Surface ditch – V-shaped, 1.0 ft deep minimum and 3.0 ft wide across the top, or as shown.

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 SMALL DITCH EXCAVATION

- A. Form the ditch as shown.
- B. Place and compact excavated material in embankments. Refer to Section 02056.

3.2 SURFACE DITCH EXCAVATION

- A. Construct the ditch along the contour of the ground.
- B. Place excavated material to form a berm on the downhill side of the ditch.
- C. Shape the ditch and berm so that power-driven mowers can operate on the graded surface.

END OF SECTION

SECTION 02372

GABIONS AND REVET MATTRESSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rock filled gabions and revet mattresses.

1.2 RELATED SECTIONS

- A. Section 02075: Geotextiles
- B. Section 02317: Structural Excavation

1.3 REFERENCES

- A. AASHTO T 85: Specific Gravity and Absorption of Coarse Aggregate
- B. AASHTO T 96: Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine
- C. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- D. ASTM A 975: Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
- E. ASTM D 7014: Assembly and Placement of Double-Twisted Wire Mesh Gabions and Revet Mattresses

1.4 DEFINITIONS

- A. Gabion – A double-twisted wire mesh enclosure uniformly partitioned into internal cells, interconnected with other similar units, and filled with rock to form flexible, permeable, monolithic structures.
- B. Revet mattress – Similar to gabions but having a larger footprint and smaller height.
- C. Rock diameter - The equivalent diameter (average width) of a given rock.

1.5 SUBMITTALS

- A. Wire enclosure manufacturer's product data sheet and installation instructions, for information.
 - 1. Conform to ASTM D 7014 for installation instructions.
- B. The rock source, gradation, and laboratory values for the properties in Table 1, for information.

PART 2 PRODUCTS

2.1 GABIONS AND REVET MATTRESSES

- A. Wire enclosure
 - 1. Gabion
 - a. Galvanized 8 x 10 wire mesh type, mesh opening 3.25 inch nominal x 4.50 inch nominal. Refer to ASTM A 975
 - b. PVC coated galvanized 8 x 10 wire mesh type, mesh opening 3.25 inch nominal x 4.50 inch nominal. Refer to ASTM A 975.
 - 2. Revet mattress
 - a. Galvanized 6 x 8 wire mesh type, mesh opening 2.50 inch nominal x 3.25 inch nominal. Refer to ASTM A 975.
 - b. PVC coated galvanized 6 x 8 wire mesh type, mesh opening 2.50 inch nominal x 3.25 inch nominal. Refer to ASTM A 975.
- B. Rock
 - 1. Hard, durable, resistant to weathering, and free from seams, cracks and other structural defects.
 - a. Do not use shale, mudstone, and other rock that may break into smaller pieces during handling.
 - b. Do not use concrete or asphalt rubble.
 - 2. Meet the properties listed in Table 1.

Table 1

Physical Properties		
Property	Value	Test Method
Specific Gravity	2.4 min	AASHTO T 85
Absorption	2% max	AASHTO T 85
Soundness of Aggregate using Sodium Sulfate or Magnesium Sulfate	12% max or 17.5% max	AASHTO T 104
Resistance to Degradation	45% max	AASHTO T 96

3. Provide rock diameters between 4 to 8 inches or as shown.
4. Retain 95 percent or more of the rock on a square screen having the same opening size as the wire enclosure.
 - a. Control gradation by sample measurement or by visual inspection, as determined by the Engineer.

2.2 EROSION CONTROL GEOTEXTILE

- A. Refer to Section 02075, except use a nonwoven 12 oz/yd² maximum average roll value.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavate and grade to provide a firm and uniform bearing surface. Refer to Section 02317.
- B. Install erosion control geotextile as shown.

3.2 GABION AND REVET MATTRESS INSTALLATION

- A. Follow manufacturer's installation instructions.
- B. Place each empty wire enclosure into its final position as shown.
 1. Tie or fasten to adjacent wire enclosures along all containing edges in order to form a continuously connected, monolithic structural unit.
- C. Place rock into the wire enclosure in a manner that ensures proper alignment, minimizes voids, avoids bulges, and prevents damage to the wire enclosure.
 1. Hand place rock on exposed vertical faces as necessary to develop a satisfactory face gradation and prevent loss of smaller rock fill through the openings.

END OF SECTION

SECTION 02373

RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Loose and compacted riprap.

1.2 RELATED SECTIONS

- A. Section 02075: Geotextiles
- B. Section 02317: Structural Excavation

1.3 REFERENCES

- A. AASHTO T 85: Specific Gravity and Absorption of Coarse Aggregate
- B. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

1.4 DEFINITIONS

- A. D_{50} - The median rock diameter within a riprap mass for which 50 percent of the rocks are smaller and 50 percent are larger.
- B. Rock diameter - The equivalent diameter (average width) of a given rock.

1.5 SUBMITTALS

- A. The rock source, gradation, and laboratory values for the properties in Table 1, for information.

PART 2 PRODUCTS

2.1 RIPRAP

- A. Rock
1. Angular, hard, durable, resistant to weathering and free from seams, cracks and other structural defects.
 - a. Do not use shale, mudstone, or other rock that may break into smaller pieces in the process of handling and placing.
 - b. Do not use concrete or asphalt rubble.
 2. Meet the properties listed in Table 1.

Table 1

Physical Properties		
Property	Value	Test Method
Specific Gravity	2.5 min	AASHTO T 85
Absorption	2% max	AASHTO T 85
Soundness of Aggregate using Sodium Sulfate or Magnesium Sulfate	12% max or 17.5% max	AASHTO T 104
Resistance to Degradation	40% max	AASHTO T 96

3. Well graded rock throughout the riprap layer to produce a dense mass. Refer to Table 2 for riprap gradation limits.
 - a. Control gradation by sample measurement or by visual inspection, as determined by the Engineer.

Table 2

Riprap Gradation Limits	
Rock Diameter Range (ft)	Percent of Gradation Smaller Than
1.5D ₅₀ to 1.7D ₅₀	100
1.2D ₅₀ to 1.4D ₅₀	85
1.0D ₅₀ to 1.15D ₅₀	50
0.4D ₅₀ to 0.6D ₅₀	15
0.1D ₅₀	10

2.2 EROSION CONTROL GEOTEXTILE

- A. Refer to Section 02075, except use a nonwoven 12 oz/yd² maximum average roll value.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavate and grade to provide a firm and uniform bearing surface. Refer to Section 02317.
- B. Install erosion control geotextile as shown.

3.2 LOOSE RIPRAP

- A. Place rocks to provide a secure unsegregated dense mass.
 - 1. Distribute and manipulate the rocks so that the larger rocks are uniformly distributed and the smaller rocks serve to fill the spaces between the larger rocks.

3.3 COMPACTED RIPRAP

- A. Place rocks conforming to this Section, Article 3.2.
- B. Compact riprap to remove irregular surface protrusions larger than 3 inches.

END OF SECTION

SECTION 02376

ROLLED EROSION CONTROL PRODUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rolled Erosion Control Products (RECP) installed on disturbed areas of a construction project, including steep slopes and roadside ditches, to prevent erosion and sedimentation and assist in establishment of vegetation growth.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM D 4355: Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- B. ASTM D 4595: Tensile Properties of Geotextiles by the Wide-Width Strip Method
- C. ASTM D 6459: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion
- D. ASTM D 6460: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion
- E. ASTM D 6525: Measuring Nominal Thickness of Rolled Erosion Control Products
- F. ASTM D 6818: Ultimate Tensile Properties of Rolled Erosion Control Products
- G. ASTM D 7207: Determination of Unvegetated Rolled Erosion Control Product (RECP) Ability to Protect Sand from Hydraulically-Induced Shear Stresses under Bench-Scale Conditions

1.4 DEFINITIONS

- A. Erosion Control Blanket (ECB) – Temporary RECP composed of processed natural or polymer fibers mechanically, structurally, or chemically bound between two natural fiber or synthetic nettings to form a continuous matrix, used to provide erosion control and facilitate vegetation establishment along slopes.
- B. Flexible Channel Liner (FCL) – Temporary RECP machine-produced mat consisting of elongated natural materials that are bound between two slow degrading natural fiber or synthetic nettings to form a continuous matrix, used to reduce erosion and aid vegetation establishment within recently constructed channels, ditches and swales.
- C. Rolled Erosion Control Products (RECP) – Prefabricated blankets or netting formed from both natural and synthetic materials, designed to be installed to a disturbed area and with vegetative growth, used to prevent or reduce erosion.
- D. Turf Reinforcement Mat (TRM) – Permanent RECP composed of non-degradable synthetic fibers, filaments, nets, wire mesh or other elements processed into a permanent, three-dimensional matrix, designed to protect high flow channels, ditches and very steep slopes.

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original ultra violet (UV) weather-resistant factory labeled packages showing the name of the manufacturer and product description.
 - 1. Protect from damage due to climatic conditions or construction operations.

PART 2 PRODUCTS

2.1 ROLLED EROSION CONTROL PRODUCTS (RECP)

- A. Furnish the following RECP according to Table 1.
 - 1. Erosion Control Blanket
 - 2. Flexible Channel Liner
 - 3. Turf Reinforcement Mat

Table 1

Requirements for Rolled Erosion Control Products				
Property	Test Method (ASTM)	Erosion Control Blanket	Flexible Channel Liner	Turf Reinforcement Mat
Typical Functional Longevity		12 months	24 months	36 months
Minimum Tensile Strength	D 6818	75 lbs/ft	100 lbs/ft	N/A
Minimum Tensile Strength	D 4595	N/A	N/A	150 lb/ft
Maximum "C" Factor (Maximum Gradient for Slope Application)	D 6459	≤ 0.20 (2H:1V)	≤ 0.25 (1.5H:1V)	≤ 0.25 (1.5H:1V)
Minimum Shear Stress (Unvegetated Channels)	D 7207	1.75 lbs/ft ²	2.0 lbs/ft ²	3.0 lb/ft ²
Minimum Shear Stress (Vegetated Channels)	D 6460	N/A	N/A	8.0 lb/ft ²
UV Stability	D 4355	N/A	N/A	80%
Minimum Thickness	D 6525	N/A	N/A	0.25 inch

PART 3 EXECUTION

3.1 PREPARATION

- A. Complete all required grading, topsoil placement, and seeding in designated areas before installing RECP.
- B. Make soil surface stable, firm, free of rocks, roots and other obstructions.
- C. Apply the RECP within 24 hours after seeding.

3.2 INSTALLATION

- A. Minimize disturbance of the prepared seedbed when installing the product.
- B. Install product according to manufacturer's recommendations.

- C. Unroll product parallel to the primary direction of flow and place it in direct contact with the soil.
 - 1. Do not stretch the product or allow it to “tent” or bridge over surface inconsistencies during installation.
- D. Install flexible channel liner or turf reinforcement mat, within a channel, ditch or swale, to allow runoff to flow directly to the centerline of ditch, not undermining or bypassing the lined ditch.
- E. Place additional staples in areas such as swales, base of humps, against rock outcrops, and as required achieving maximum contact between the product and the soil.

END OF SECTION

SECTION 02455

DRIVEN PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Driven steel piles for structure foundations.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. AASHTO M 270: Structural Steel for Bridges
- C. ASTM A 36: Carbon Structural Steel
- D. ASTM A 252: Welded and Seamless Steel Pipe Piles
- E. ASTM D 4945: High Strain Dynamic Testing of Piles
- F. AASHTO/AWS Welding Specifications

1.4 DEFINITIONS

- A. BOR – Beginning of redrive conditions.
- B. Driving criteria – Hammer energy setting, minimum pile embedment, minimum hammer stroke or energy, and minimum blow counts.
- C. Dynamic testing – High strain dynamic testing of pile driving in accordance with ASTM D 4945 using PDA equipment and signal matching.
- D. EOD – End of driving conditions.
- E. PDA – Pile driving analysis.

1.5 SUBMITTALS

- A. Pile Driving Equipment for review before mobilizing to the project site
 - 1. Use the “Pile and Driving Equipment Data” form for each proposed hammer and pile combination.
 - 2. The form can be found at the end of this Section and the Department’s Web site.
 - 3. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
- B. Manufacturer’s product data sheets, and recommended installation instructions for each pile hammer used.
- C. Certificate of Compliance for pile products
 - 1. Include accurate test information regarding the yield strength (heat) values for each batch of piles to be used on the project
- D. Welder certifications
 - 1. Include Procedure Qualification Records when using ASTM A 252 Grade 3 steel.
 - 2. Include welders test reports for each operator, process, and position as required by AWS specifications.
 - a. Include a letter that states the certified welders have been using the process without an interruption of more than six months since being certified.
- E. Preliminary schedule for driving.

1.6 PRICE REDUCTIONS FOR NON-CONFORMING WORK

- A. Price Adjustment – Reduction for Deficient Strength Concrete
 - 1. The Department may accept concrete in pipe piles that is below the specified strength according to Section 03055.
 - 2. The quantity of the bid item for which the pay factor is applied consists of the price of the entire pile(s) for which the deficient strength test(s) are below the specified strength.
- B. Price Adjustment – Reduction for Out-of-Tolerance Piles
 - 1. Demonstrate technical adequacy for piles driven out of plumb or plan location.
 - 2. The Department will:
 - a. Reject piles driven outside the upper deviation limits shown in Table 1 below.
 - 1) No payment made for the rejected pile.
 - b. Use the Contractor’s unit bid price and the pay factors schedule presented in Table 1 to calculate the price reduction for compensation.

Table 1

Price Reduction Pay Factors For Non-Conforming Pile Driving Tolerances		
Pay Factor	Plumb % deviation from 2.0%	Plan Location inch deviation from 6 inch
1.00	0.00 to 0.40	0.00 to 0.75
0.90	0.41 to 0.80	0.76 to 1.50
0.80	0.81 to 1.20	1.51 to 2.25
0.70	1.21 to 1.60	2.26 to 3.00
0.50	1.61 to 2.00	3.01 to 3.75
0.30	2.01 to 2.40	3.76 to 4.50
0.10	2.41 to 3.00	4.51 to 6.00
0.0, Reject	> 3.00	> 6.00

- C. The Department will:
1. Apply pay factors to each pile individually based on the total measured pile length from the specified cutoff elevation.
 2. Apply only the criteria with the lowest pay factor for the deficient pile.

1.7 ACCEPTANCE

- A. Do not move pile driving equipment away from the pile foundation area until the Engineer verifies conformance with specifications of the driven piles for the current foundation.
- B. Do not demobilize pile driving equipment from the site until the Engineer verifies conformance with specifications of all driven piles for the project.

PART 2 PRODUCTS

2.1 PIPE PILES

- A. ASTM A 252, Grade 2 or Grade 3 as shown.
 1. Use new pipe pile.

2.2 HP PILES

- A. AASHTO M 270, Grade 36 or 50 as shown.
 1. Use new HP pile.

2.3 CONCRETE

- A. Class A(AE) concrete – Refer to Section 03055.
 - 1. Air entrainment requirements are waived.
 - 2. Maintain slump at the time of placement between 4 and 6 inches.

2.4 REINFORCING STEEL

- A. Meet AASHTO M 31, Grade 60.
- B. Refer to Section 03211 for vertical and spiral reinforcing steel as shown.

2.5 PILE DRIVER

- A. Use pile driving equipment that is capable of driving the piles to the required driving resistance without damaging the pile and without requiring an excessive number of blows to achieve the required tip elevation and capacity.
- B. Obtain authorization of pile driving equipment before mobilizing the pile driving equipment to the site.
- C. Remove pile driver and related equipment found to be inadequate for the project pile driving conditions.
 - 1. Revise and resubmit the Pile and Driving Equipment Data form as necessary until an acceptable pile driver system is determined.
 - 2. Mobilize the acceptable pile driver system.
- D. Equip the pile driver according to manufacturer's recommendations.
- E. Leads
 - 1. Use with all hammer types.
 - 2. Hold in the required position with guys, stiff braces, or both.
 - 3. Hold the pile parallel to the leads.
 - 4. Accommodate the maximum length of the pile segment and extend leads to the lowest point that the hammer must reach.
 - 5. Use fixed leads if necessary to maintain required driving tolerances (as described in this Section, article 3.3, paragraph C).
- F. Drive Cap or Drive Head
 - 1. Fits the top of pile and provides full bearing.
 - 2. Drive cap to have a machined surface to fully engage the end of the pipe for pipe piles.

- G. Hammer
 - 1. Fully operable adjustable settings.
 - 2. Rated energy greater than or equal to the value shown.
 - 3. Replace the cushion when it loses 25 percent or more of its original thickness.
 - a. Inspect hammer cushion in the presence of the Engineer before beginning pile driving, and after every 100 hours of pile driving.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavate foundations before driving piles.
- B. Dewater excavation to at least 1ft below bottom of foundation, and maintain at all times during pile foundation operations.
- C. Notify the Engineer of conflicts between the designated location of new piles and the locations of existing piles (from previous construction), existing utilities, old foundations, and other potential conflicts.
 - 1. The Engineer will revise new pile locations as required.

3.2 DYNAMIC ANALYSIS OF PILE DRIVING

- A. Notify the Engineer at least seven calendar days before pile driving begins on the project and at least five calendar days before pile driving begins on each subsequent abutment and bent foundations.
- B. The Department conducts at least one dynamic test for each foundation (abutment or bent) phase. Refer to ASTM D 4945.
 - 1. The Department performs an EOD dynamic test using PDA equipment on the first pile driven at each foundation and foundation-phase to prevent overstressing the pile and to verify pile capacity.
- C. Cooperate with the Department in conducting dynamic testing, including the following:
 - 1. Provide adequate space and conditions for the PDA vehicle and related equipment.
 - 2. Attach, check, and remove PDA gauges as necessary by one of the following methods:
 - a. Climb the driver leads

- b. Provide a platform at least 4 ft square with a 4 ft high safety rail equipped to be raised to the top of the pile located in the leads to provide Department personnel safe access.
 - 3. Install PDA gauges after placing pile in the leads.
 - a. Allow up to one hour per pile for installation of PDA gauges if Department personnel is conducting the dynamic testing.
 - b. Allow one additional hour for installation of measuring equipment after splicing if splicing is performed and additional testing is required.
 - 4. Reduce the energy of the hammer or make other adjustments as necessary if the pile stress exceeds the specified limit during the test.
 - 5. Drive the pile until the required driving resistance is achieved as determined by the dynamic testing, and the other pile driving criteria is achieved unless otherwise indicated by the Engineer. Refer to this Section, Article 3.2, paragraph D.
- D. The Engineer, in coordination with the Department's Geotechnical Engineer of Record, evaluates the driving resistance and driving stresses, and establishes driving criteria using a wave equation analysis program with signal matching.
 - 1. Do not complete the driving of other piles in the foundation until the Engineer gives notice that the test results indicate that sufficient capacity has been obtained and the driving criteria for the remainder of the piles in the foundation has been established.
- E. Maximum allowable driving stress is $0.9 \times \text{pile yield stress (Fy)}$.
 - 1. Reduce hammer energy or make other appropriate adjustments to keep driving stresses below $0.9F_y$.
- F. The Department will perform a BOR dynamic test on the pile after a sufficient time period to allow for set-up capacity.
 - 1. 24 or more hours after the initial driving of the pile.
 - 2. BOR dynamic testing is not performed using a cold hammer.
- G. The Department may require the dynamic testing of additional piles and reestablishing driving criteria for the remaining piles within the foundation if pile does not meet the established driving criteria.

3.3 PILE INSTALLATION

- A. Pre-drill or pre-auger as shown, if the designated pile tip elevation cannot be reached by the pile driver, or if otherwise authorized by the Engineer.
 - 1. Do not drill holes with a diameter larger than the maximum pile dimension.

- B. Pile Splicing
1. Use no more than one spliced section less than 6 ft in length, and no more than one other spliced section less than 30 ft in length for each pile.
 2. Examine the driven pile section for distortion from its original shape or other damage from pile driving operations, before splicing pile sections.
 - a. Remove the damaged portion before splicing the next segment.
 3. Match the alignment of the new pile segment to the previously driven pile segment.
 4. Butt weld the entire pile cross-section using full penetration welds as shown, according to the authorized Welding Procedure Specification (WPS) for pile welds and conforming to the limitations of AWS D1.1.
 - a. Table 4.5. Both ASTM A 36 and ASTM A 252 Grade 1 and 2 may be treated as prequalified base metals under Group 1.
 - b. ASTM A 252 Grade 3 will not be considered a prequalified base metal unless the steel has a Carbon Equivalent (CE) of 0.30 percent or less.
 - c. Develop a Procedure Qualification Record (PQR) for all welding using Grade 3 steel or provide documentation that the chemistry of the steel meets the CE requirements.
 5. Use welders qualified according to AWS D1.1 Clause 4. Part C Performance Qualification for the position, process and pile size used on the project.
 6. The Engineer may request additional nondestructive testing (NDT), such as ultrasonic testing of welds. Ultrasonic defect indications will be evaluated according to the statically loaded criteria of AWS D1.1.
 - a. Perform repair and additional inspection if additional testing identifies defects warranting rejection.
 - b. The Department will pay the cost of the additional testing and inspection if the additional NDT does not identify defects warranting rejection.
- C. Keep driven pile within 6 inches of the designated plan location and within 2 percent of vertical (plumb) throughout the total length of the pile including bending of the buried portion of the pile, equivalent to 0.25 inches in one foot, or 0.60 inches in 30 inches.
1. Keep side of pile at least 6 inches away from nearest edge of pile cap.
 2. Do not fill pipe piles with concrete until the Engineer notifies that the criteria have been met.

3. Drive additional piles as required to replace damaged piles and piles driven out of plumb or plan location at locations designated by the Department.
- D. Redrive piles that are raised due to the driving of adjacent piles after initial driving.
- E. Notify the Engineer of any water collecting in open pipe piles so the piles can be evaluated for possible damage.
- F. Cover open ends of open-ended pipe piles to prevent the collection of precipitation, other sources of water, or debris.
- G. Cutting Piles
 1. Verify that each driven pile has met the established driving criteria before cutting piles.
 2. Remove damaged material from the top of the piles.
 3. Cut off piles with clean, straight-line cuts to the designated elevation at a right angle to the pile axis.
 4. Embed the tops of piles in the concrete pile cap as shown.
- H. Fill space between the pile and the surrounding soil with grout or flowable fill to reestablish lateral support.
- I. Remove loose and displaced materials from the foundation area around the completed piles leaving a clean, solid surface to receive the concrete.
- J. Level irregularities of granular fill in the foundation area before placing abutment or pile cap.

3.4 CONCRETE FILLING OF PIPE PILES

- A. Remove water and debris from pipe piles before filling with concrete.
- B. Do not fill pipe piles with concrete before the Engineer confirms that the piles comply with the specified tolerances and pile driving criteria.
- C. Avoid segregation of the concrete.
- D. Use a tremie or drop chute to prevent concrete from contacting either the rebar cage or the pipe wall.
 1. Arrange placement aids such as chutes and pipes so concrete does not separate and flows freely without being pushed or shoveled.

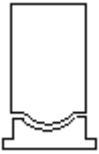
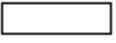
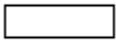
- E. Use high frequency internal vibrators to consolidate concrete to at least 3 ft below the bottom of the rebar cage or to at least 13 ft below the pile cutoff level, whichever is deeper.
 - 1. Do not vibrate concrete that has taken initial set.
 - 2. Vibrate concrete again after inserting cage to eliminate voids around the cage if rebar cage is inserted after concrete has been placed.
- F. Place the rebar cage into the pipe pile when the concrete reaches the planned bottom elevation of the rebar cage.
 - 1. Support the rebar cage from the top until the concrete reaches the top of the pile.
 - 2. Keep rebar cage within 2 inches of the required vertical location.
- G. Secure rebar cage in position until concrete is set.
- H. Provide lighting to the work site if concrete placement is to occur after daylight hours so all operations are plainly visible.

END OF SECTION

Sheet # _____
Pile and Driving Equipment Data

Project No: _____
 Project Name: _____ County: _____
 Drawing No: _____
 General Contractor: _____
 Pile Driving Contractor/Subcontractor: _____
 Phone: _____ FAX: _____
 (Piles driven by, foreman): _____

Date Submitted: _____

Hammer Components		Hammer	Manufacturer: _____ Model: _____ Type: _____ Serial No: _____ Manufacturer's Maximum Rated Energy: _____ (k-ft) Stroke at Maximum Rated Energy: _____ (ft) Range in Operating Energy: _____ to _____ (ft-k) Range in Operating Stroke: _____ to _____ (ft) Modifications: _____																										
		Ram	Ram Weight: _____ (lbs) Ram Length: _____ _____ (ft) _____ (for diesel hammers)																										
		Anvil	Ram Cross Sectional Area: _____ (in ²) (With diesel hammers) Anvil Weight: _____ (lbs)																										
		Hammer Cushion	<table style="width: 100%; border: none;"> <thead> <tr> <th></th> <th style="text-align: center;">Material #1</th> <th style="text-align: center;">Material #2</th> </tr> </thead> <tbody> <tr> <td>Name:</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Area:</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>(in²)</td> <td></td> <td></td> </tr> <tr> <td>No. of Plates:</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>Thickness:</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>(in)</td> <td></td> <td></td> </tr> <tr> <td>Mod. of Elasticity - E:</td> <td>_____</td> <td>_____ (psi)</td> </tr> <tr> <td>Coeff. of Restitution - e:</td> <td>_____</td> <td>_____</td> </tr> </tbody> </table>		Material #1	Material #2	Name:	_____	_____	Area:	_____	_____	(in ²)			No. of Plates:	_____	_____	Thickness:	_____	_____	(in)			Mod. of Elasticity - E:	_____	_____ (psi)	Coeff. of Restitution - e:	_____
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Coeff. of Restitution - e:	_____	_____																											
Drive Cap	Helmet Weight: _____ (lbs) Bonnet Anvil Block Drive Head																												
Pile		Pile Cushion (Only for Concrete or Timber Piles)	Material: _____ Area: _____ (in ²) No. of Sheets: _____ Thickness/Sheet: _____ (in) Total Thickness of Pile Cushion: _____ (in) Mod. of Elasticity - E: _____ (psi) Coeff. of Restitution - e: _____																										
		Pile	Diameter: _____ (in) Wall Thickness: _____ (in) Taper (if any): _____ Length in Leads: _____ (ft) Ordered Length: _____ (ft) Required Driving Resistance: _____ (kips) Description of Splice: _____ Tip Treatment/Plate Description: _____																										

Use Separate Data Sheet for Each Proposed Hammer and Pile/Structure Combination

SECTION 02466
DRILLED SHAFTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drilled shafts for structure foundations.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Procedure to place concrete under water. Refer to this Section, Article 3.5, paragraph A.

1.6 NON-CONFORMANCE

- A. A drilled shaft is non-conforming when it fails to be completed within the required tolerances.
 - 1. Furnish equipment, materials and work necessary to correct out-of-tolerance drilled shaft construction.

1.7 ACCEPTANCE

- A. Drilled shafts may be accepted at a reduced price when the concrete compressive strength is less than the specified 28-day minimum compressive strength.
 - 1. Use price adjustment pay factors according to Section 03055.
 - 2. The Department applies the price reduction for 28-day compressive strength to the measured length of each shaft containing concrete with tested strength less than the specified compressive strength.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class A(AE) Refer to Section 03055.
 - 1. Keep slump between 4 and 8 inches when tested at the truck.
- B. Modify as follows when placed under water:
 - 1. Use at least seven bags of cement per cubic yard.
 - 2. Provide equipment capable of pumping specified concrete.
 - 3. Use high range water reducers (super plasticizers) according to Section 03055.

2.2 REINFORCING STEEL

- A. Refer to Section 03211.

2.3 DRILLING EQUIPMENT

- A. Capable of:
 - 1. Drilling holes to the required diameter, location, alignment, and depth in the type of materials present at the shaft locations.
 - 2. Installing and removing casing.

PART 3 EXECUTION

3.1 PREPARATION

- A. Drilling Shaft Excavations
 - 1. Drill straight, vertical shaft excavations to the tip elevations shown or as directed by Engineer.
 - 2. Remove all loose material from the bottom of the excavations before placing concrete.
 - 3. Do not use water or slurry for drilling operations.
 - 4. Do not begin drilling for a shaft located three diameters center-to-center or closer to an adjacent completed shaft until at least 48 hours after placing concrete for the completed shaft.
 - 5. Do not begin drilling for a shaft located between three and five diameters center-to-center from an adjacent completed shaft until at least 24 hours after placing concrete for the completed shaft.
- B. Casing
 - 1. Furnish and place casing when necessary to prevent the drilled hole from caving, including when groundwater is encountered.
 - 2. Remove casing as the concrete is placed.

- a. Keep the bottom of the casing between 2 ft and 5 ft below the top of the concrete surface when withdrawing.
 - b. Prevent concrete separation when withdrawing the casing.
- C. Uncased Shaft Excavations
 - 1. Drill uncased (dry, non-caving) shaft excavations in a continuous operation without interruption.
- D. Remove all muck, laitance, and degraded concrete from the shaft.

3.2 CONSTRUCTION TOLERANCES

- A. Install the drilled shaft within 3 inches horizontally of the plan position at the plan elevation for the top of the shaft.
- B. Install the drilled shaft so the vertical alignment of the shaft excavation does not vary from the plan alignment by more than 0.25 inches per foot of depth.
- C. Install the drilled shaft so the top of the reinforcing steel cage is no more than 2 inches above or below the plan elevation.

3.3 REBAR CAGES

- A. Rigidly brace the reinforcing cage with additional reinforcing steel as needed to retain its configuration during handling and construction.
 - 1. Do not use loose bars.
 - 2. Pick cage in several locations as necessary to maintain cage shape and alignment during placement.

3.4 CONCRETE PLACEMENT

- A. Fill uncased (dry, non-caving) holes immediately after drilling and in a continuous manner.
 - 1. Fill cased drilled holes within 24 hours after drilling.
- B. Use a tremie or spout to prevent concrete from striking the steel-reinforcing cage.
 - 1. Do not allow concrete to free-fall more than 5 ft.
- C. Vibrate the concrete for at least the top 10 ft of the shaft.

3.5 CONCRETE PLACEMENT UNDER WATER

- A. Obtain Engineer's authorization to place concrete under water.

- B. Use concrete pumping equipment capable of pumping at least 50 yd³/hr against a minimum 20 ft head of concrete measured from the discharge end of the pump hose extension of the tremie pipe.
- C. Use a rigid steel pipe pump hose extension for the tremie pipe with tight couplings straight to within ½ inch in 10 ft.
 - 1. Length of extension- At least the depth of the shaft.
 - 2. Inside diameter- Greater than or equal to the concrete pump discharge hose but not more than one half the inside diameter of the reinforcing cage.
- D. Purge the tremie pipe of water.
 - 1. Insert a sturdy plastic ball or equivalent into the top of the pump hose extension before connecting the hose from the concrete pump.
 - 2. The ball must fit snugly into the pump hose extension when the hose is filled. The hose must be strong enough to resist rupture.
 - 3. Prime the hose and pipe with cement slurry.
- E. Lower a small diameter pole with an attached flat plate into the hole to determine the top surface of concrete.
 - 1. Mark both pole and pipe so that the length of penetration can be immediately determined.
 - 2. Prevent the end of the pipe from becoming plugged with soil from the bottom of the hole.
- F. Begin pumping the concrete immediately after setting the reinforcing cage and tremie pipe in the hole. Do not begin raising the tremie pipe until the concrete surface is 10 ft above the bottom of the pipe.
- G. Keep the bottom of the tremie pipe at least 5 ft below the top of the concrete until the placement is complete and all muck, laitance, and degraded concrete is removed. Provide a positive hold down if the pipe floats so the minimum 5 ft penetration is maintained.
- H. Do the following if the tremie pipe plugs, equipment breaks down or loss of the seal at the end of the pipe occurs:
 - 1. Pull the tremie pipe, reset it 2 ft below the top of the concrete, and purge it.
 - 2. Lower the tremie pipe to at least 5 ft below the top of the placement and continue pumping concrete until all degraded concrete has lifted to the top of the shaft.
 - 3. Remove all muck, laitance, and degraded concrete.

END OF SECTION

SECTION 02610

DRAINAGE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe used to convey surface water and stormwater by gravity flow.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02317: Structural Excavation
- C. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 170: Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- B. AASHTO M 196: Corrugated Aluminum Pipe for Sewers and Drains
- C. AASHTO M 207: Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
- D. AASHTO M 243: Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
- E. AASHTO M 245: Corrugated Steel Pipe, Polymer Precoated, for Sewers and Drains
- F. AASHTO M 294: Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
- G. AASHTO M 304: Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
- H. AASHTO M 330: Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
- I. AASHTO MP 20: Steel Reinforced Polyethylene Pipe

- J. AASHTO PP 63: Pipe Joint Selection for Highway Culvert and Storm Drains
- K. ASTM C 443: Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- L. ASTM C 990: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- M. ASTM D 1056: Flexible Cellular Materials—Sponge or Expanded Rubber
- N. ASTM F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 DEFINITIONS

- A. Deflection – Deviation from a pipe's original shape.
- B. NASSCO – National Association of Sewer Service Companies.
- C. Nominal Diameter – Inside diameter of the pipe specified.
- D. Pipe Interior Roughness:
 - 1. Corrugated – Interior surface that is formed into a series of alternating crests and valleys with a Manning's "n" coefficient greater than 0.013.
 - 2. Smooth Lined – Interior surface that is essentially smooth, with a Manning's "n" coefficient less than or equal to 0.013.
- E. Profile Wall Pipe – Pipe that has a smooth interior wall with an exterior that is either is ribbed, corrugated, or smooth.
 - 1. The wall may contain hollow cores.
- F. Spring Line – Location of the maximum horizontal dimension of a pipe.
- G. Thermoplastic Pipe – Pipe made from plastic materials such as HDPE, PVC, and Polypropylene.

1.5 SUBMITTALS

- A. Manufacturer's certificate of compliance.
- B. Manufacturer's data sheets and installation instructions.

- C. Documentation from AASHTO NTPEP showing compliance with Table 3 for the thermoplastic pipe material and diameter supplied for information.
- D. NASSCO Pipeline Assessment certification for remote video technician for information.
- E. Pipe inspection report for each pipe for review. Include at least the following:
 - 1. The project number, date, and time of the inspection for each pipe inspection, the pipe identification used in the plan set, and type and size of pipe.
 - 2. A video recording of each pipe inspection in a digital format for remote inspection.
 - 3. Written and still image documentation of locations where alignment deviations, joint gaps, pipe damage, and any other deficiencies were observed.
 - 4. Written documentation of deflection testing and measurements.

1.6 ACCEPTANCE

- A. General
 - 1. Each pipe is accepted for payment after verifying that the following criteria have been met:
 - a. Alignment
 - b. Deflection
 - c. Joint gap
 - d. Damage
 - 2. Proposed resolutions for nonconforming pipes require the seal of a licensed Professional Engineer competent in the structural design of the pipe material being evaluated.
- B. Alignment
 - 1. Do not exceed the installation horizontal and vertical alignment tolerances in Table 1.

Table 1

Installation Alignment Tolerances		
Design Grade	Horizontal	Vertical*
		inch/100 ft
> 1%	Not to exceed the pipe manufacturer's requirements	1½
0.5% - 1%		1
< 0.5%		½

* Increase tolerance by 50 percent for pipes with silt-tight joints.

- C. Deflection
 - 1. Do not exceed a 5 percent shape change from the nominal diameter.
 - a. Proposals for acceptance of pipes with a deflection greater than 7.5 percent will be rejected.
- D. Joint Gap
 - 1. Do not exceed the joint separation, measured along the length of pipe, in Table 2.
 - a. Repair or replace joints that show visible signs of soil or water infiltration.

Table 2

Joint Gap Tolerances	
Nominal Diameter (inches)	Separation (inches)
12 to 36	0.75
42 to 48	1.00
54 to 90	1.25
96 to 144	1.75

- E. Damage
 - 1. Pipes are to be free from:
 - a. Cuts, cracks, spalls, chips, or punctures.
 - 1) Cracks are allowable up to 0.01 inch in width for reinforced concrete pipe
 - b. Loss or delamination of coatings.
 - c. Exposed reinforcing steel.
 - d. Imperfect concrete mixing and casting such as honeycomb or open texture.

PART 2 PRODUCTS

2.1 PIPE

- A. General
 - 1. Provide pipe according to the size, material or interior roughness, and joint type specified.
 - a. Meet the material requirements in Table 3.
 - b. Meet the joint requirements of AASHTO PP 63 for silt-tight and leak-resistant joints.
 - c. Determine the strength and thickness of the pipe required based on the cover over the pipe. Refer to the DG Series Standard Drawings.

- d. Maintain the same type of pipe material, joint, strength, and thickness throughout the entire length of pipe.
2. Internally label each section of pipe with the manufacturer's name or trademark, nominal diameter, and manufacture date. Include the pipe class, gauge, and coating according to the pipe material type.
 - a. Place the pipe so that the location of the label is above the spring line of the pipe.

Table 3

Pipe Material Specifications	
Interior Roughness and Material Type	
Corrugated	
Polymer Coated Corrugated Steel Pipe and Pipe Arch	AASHTO M 245
Aluminum Corrugated Pipe and Pipe Arch	AASHTO M 196
Smooth	
Profile Wall Polyethylene (HDPE) Pipe	AASHTO M 294
Profile Wall Polyvinyl Chloride (PVC) pipe	AASHTO M 304
Profile Wall Polypropylene Pipe	AASHTO M 330
Steel Reinforced Thermoplastic Ribbed Pipe	AASHTO MP 20
Polymer Coated Spiral Rib Steel Pipe and Pipe Arch	AASHTO M 245
Spiral Rib Aluminum Pipe and Pipe Arch	AASHTO M 196
Reinforced Concrete Pipe	AASHTO M 170
Elliptical Reinforced Concrete Pipe	AASHTO M 207

- B. Reinforced Concrete Pipe
 1. Use a Department prequalified supplier of precast concrete products.
 2. Use Type V Cement. Refer to Section 03055.
 3. Do not cast lift holes except for circular pipe that has a nominal diameter greater than 54 inches or any elliptical pipe.
 - a. Plug and seal lift holes in a manner such that the pipe section will meet pressure requirements.
 4. Use a rubber gasket for circular reinforced concrete pipe. Refer to ASTM C 443.
 5. Use a mastic joint sealant for elliptical reinforced concrete pipe. Refer to ASTM C 990.
- C. Metal Pipe – Steel and Aluminum
 1. Do not allow pipes of different types of metal to contact each other.

2. Use rubber gaskets on all connecting bands. Refer to ASTM D 1056 for flat gaskets and ASTM C 443 for O-ring gaskets.
 3. Use bands with projections (dimple bands) only in extension of existing pipes or a field cut where annular corrugations do not exist.
- D. Thermoplastic Pipe - HDPE, PVC, Polypropylene and Steel Reinforced Thermoplastic Ribbed Pipe
1. Use an AASHTO NTPEP compliant supplier of thermoplastic pipe.
 2. Do not use in permanent above ground installations.
 3. Do not use greater than 36 inch diameter for PVC pipe.
 4. Do not use greater than 60 inch diameter for HDPE, Polypropylene, and Steel Reinforced Thermoplastic Ribbed pipe.
 5. Use bell and spigot joints with an elastomeric rubber gasket. Refer to ASTM F 477.

2.2 PIPE FOUNDATION, BEDDING AND BACKFILL MATERIAL

- A. Refer to Section 02056.

2.3 ASPHALT MASTIC

- A. Refer to AASHTO M 243.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and Backfill
1. Refer to Section 02317 and DG Series Standard Drawings.
 2. Keep trenches free from water.
 3. Grade and prepare the bottom of the trench to provide a firm and uniform bearing throughout the entire length of the pipe.
 - a. Do not use blocking to bring the pipe to grade.
 - b. Shape the pipe foundation and bedding to have recesses to fit any projecting hubs or bells.
 4. Remove and relay or replace pipe that is out of alignment, not joined properly or damaged before placing backfill.
- B. Follow manufacturer's recommendations for connecting pipes and for connecting pipe to end sections, concrete headwalls, catch basins, and similar structures.
1. Do not allow pipes of different types of metal to contact each other.
 2. Spray or brush-coast aluminum pipe contacting concrete with asphalt mastic to a minimum thickness of 0.05 inch.

3.2 POST INSTALLATION PIPE INSPECTION

A. General

1. Inspect pipes after installation of pipe, placement of backfill and before placing pavement or finished grade according to Table 4 and Table 5.

Table 4

Roadway Functional Classification	Percent of Pipes to Inspect
Interstate and Arterial	100
Collectors and Local	50

Table 5

Pipe Testing Requirements				
Pipe Size	Visual		Deflection*	
	Manual	Remote	Manual	Mandrel
≤ 48-inch dia.		X		X
> 48-inch dia.	X		X	

* Deflection testing is required for circular metal and thermoplastic pipe only.

2. The Engineer will determine which pipes to inspect when the percentage of pipes to inspect is less than 100 percent.
 - a. Inspect additional pipes with apparent defects and as directed by the Engineer.
3. Inspection is not required for pipes less than 20 ft in length.
4. Notify the Engineer at least 24 hours before performing an inspection.
5. Clean and flush the pipe with water immediately before the inspection.
 - a. Remove and dispose material and debris from pipes.

B. Remote Inspection

1. CCTV Equipment
 - a. Record video using a crawler mounted camera capable of panning and tilting to a 90 degree angle with the axis of the pipe and rotating 360 degrees.
 - b. Center the camera head in the pipe both vertically and horizontally to allow a clear picture of the entire periphery of the pipe.

- c. Video image must be continuously illuminated, clear, focused, and free from roll, static, or other image distortion qualities that may prevent the reviewer from evaluating the pipe's condition.
 - 1) Calibrate the video's lighting and focus to view the internal markings within the pipe.
 - 2. CCTV Inspection
 - a. Remote video inspection operator must have a current NASSCO Pipeline Assessment certification.
 - b. Use the video image to observe horizontal and vertical alignment deviations, joints gaps, and pipe damage.
 - 1) Document all observations with captions in the video.
 - 2) Note each location and provide a still image in the inspection report.
 - c. Do not move the crawler through the pipe at a speed greater than 30 ft/minute.
 - 1) Stop the crawler and video the entire circumference at each joint.
 - 2) Stop the crawler and zoom when necessary to video observations.
- C. Manual Inspection
 - 1. Perform manual inspection for pipes in the presence of the Engineer.
 - a. Follow UOSH requirements for inspecting confined entry spaces.
 - 2. Observe and document the following:
 - a. Deflection - Take the following measurements every 10 ft along the length of the pipe to the nearest $\frac{1}{4}$ inch:
 - 1) Vertically from the crown to invert.
 - 2) Horizontally at the spring line.
 - 3) Two measurements, each diagonally at 45 degrees to the pipe springline.
 - b. Cracks – Measure cracks using a device capable of measuring 0.01 inch.
 - c. Joint Gaps – Measure the widest separation at each joint to the nearest $\frac{1}{4}$ inch.
 - d. Damage.
- D. Mandrel Inspection
 - 1. Perform the mandrel inspection for pipes in the presence of the Engineer or representative.
 - a. Verify the diameter of the mandrel with a proving ring or other method according to manufacturer's recommendations.

2. Mandrel
 - a. Contain at least nine equally spaced runners (40 degree angles).
 - b. Length not less than the diameter.
3. Deflection test
 - a. Pull a mandrel that is 5 percent less than the pipe nominal inside diameter.
 - b. Perform the following if the mandrel does not pass:
 - 1) Record the maximum distance achieved from the inlet side.
 - 2) Remove the mandrel and continue the inspection from the outlet end of the pipe toward the inlet end. Record the maximum distance achieved from the outlet side.
 - 3) Repeat inspection with a mandrel that is 7.5 percent less than the pipe nominal inside diameter.

END OF SECTION

SECTION 02611

DIVERSION BOX GATE AND FRAME

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for constructing gate and frame for hand slide gates or for screw gates and frames.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 218: Steel Sheet, Zinc-Coated (Galvanized) for Corrugated Steel Pipe
- C. ASTM A 36: Carbon Structural Steel
- D. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- E. ASTM A 575: Steel Bars, Carbon, Merchant Quality, M-Grades
- F. ASTM D 2000: Rubber Products in Automotive Applications

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Submit for approval two weeks in advance of fabrication:
 - 1. Diversion box screw gate and frame shop drawings
 - 2. Installation procedures
 - 3. Fabrication methods

PART 2 PRODUCTS

2.1 BLADES AND METAL FRAMES FOR HAND-SLIDE GATES

- A. Zinc coated steel. Refer to and comply with AASHTO M 218.

2.2 CONCRETE

- A. Class AA(AE) concrete. Refer to Section 03055.

2.3 REINFORCING STEEL

- A. Refer to Section 03211.

2.4 FRAME AND FLUSH BOTTOM CLOSURE

- A. Carbon steel for frame and flush bottom according to ASTM A 36.
- B. Galvanizing frame and flush bottom according to AASHTO M 111.
- C. Galvanized fastener according to ASTM A 307.
- D. Threaded carbon steel according to ASTM A 575.
- E. Rubber seal for flush bottom according to ASTM D 2000, Grade AA 625 or BC 610 to 615.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hand-Slide Gate – Finish the concrete frame according to Section 03310.
- B. Install the screw gate and frame according to shop drawings so the gate opens and closes smoothly.

END OF SECTION

SECTION 02613

DRAINAGE PIPE END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete and prefabricated steel end sections for drainage pipes.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03056: Self-Consolidating Concrete (SCC)

1.3 REFERENCES

- A. AASHTO M 218: Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe
- B. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- C. ASTM D 1056: Flexible Cellular Materials – Sponge or Expanded Rubber

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 CONCRETE END SECTION

- A. Concrete
 - 1. Wet cast - Class AA(AE). Refer to Section 03055.
 - 2. Self-Consolidating Concrete. Refer to Section 03056.
- B. Refer to DG Series Standard Drawings.
- C. Use a Department prequalified supplier of precast concrete products.

2.2 STEEL END SECTION

- A. End Section: Galvanized steel sheeting according to AASHTO M 218.
- B. Safety Bar for Safety End Section: Schedule 40 ASTM A 500 Class B steel pipe. Galvanize after fabrication according to AASHTO M 111.
- C. Smooth Tapered Sleeve, when required: Galvanized steel sheeting according to AASHTO M 218.
- D. Refer to DG Series Standard Drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish precast concrete or prefabricated steel end sections compatible with the adjoining pipe.

3.2 INSTALLATION

- A. Prepare a smooth foundation free of rock and debris, capable of uniformly supporting the end section.
- B. Place the end section at the same alignment and slope as the adjoining pipe.
- C. Embed the toe plate for steel end sections.
- D. Connect the end section to the adjoining pipe according to the DG Series Standard Drawings.
 - 1. Use a $\frac{3}{8}$ inch neoprene flat gasket when connecting to a dissimilar metal. Refer to ASTM D 1056.
- E. Backfill and grade slopes to match the end section.

END OF SECTION

SECTION 02618

DRAINAGE PIPE LINER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drainage lining methods such as polyvinyl chloride (PVC) fold-and-form, cured in place pipe (CIPP), and segmental thermoplastic and metal pipe.

1.2 RELATED SECTIONS

- A. Section 02610: Drainage Pipe

1.3 REFERENCES

- A. AASHTO M 326: Polyethylene (PE) Liner Pipe, 300- to 1600-mm Diameter, Based on Controlled Outside Diameter
- B. AASHTO LRFD Bridge Design Specifications
- C. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D. ASTM D 1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- E. ASTM D 5813: Cured-In-Place Thermosetting Resin Sewer Piping Systems
- F. ASTM F 1216: Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
- G. ASTM F 1504: Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation
- H. ASTM F 1743: Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
- I. ASTM F 1867: Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation

- J. ASTM F 1871: Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation
- K. ASTM F 1947: Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits
- L. ASTM F 2019: Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Include the following information into a single submittal for review for each drainage pipe to be lined. Use the naming convention used in the plans for each location. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) for engineering calculations. Divide information into the sections listed below.
 - 1. Work Area
 - a. Locations and dimensions of any temporary access roads
 - b. Locations and dimensions of pipe liner assembly and insertion area “footprints”
 - c. Distance of insertion footprint from the traveled way
 - d. Amount of time the footprint will be exposed
 - e. Shoring method when excavation is proposed
 - f. Written access agreements from property owners when work area is outside Department Right of Way
 - 2. Preparation
 - a. Host pipe cleaning
 - b. Management of flows in the host pipe
 - c. Initial pipe inspection
 - 3. Installation
 - a. Method of pipe liner installation and finishing
 - b. Bulkhead and grouting details for segmental thermoplastic and metal liner
 - c. Curing method identifying required curing times, temperatures, and pressures
 - d. Any potential for producing contaminant concentrations in excess of surface water quality standards or ambient groundwater quality standards, as applicable
 - e. Control and disposal of any contaminants from materials or installation methods during and after installation
 - f. Final pipe inspection

4. Product Data
 - a. Engineering calculations and recommended size and wall thickness of pipe liner for pipe liners not specified in Section 02610.
 - 1) The host pipe is considered to be fully deteriorated and unable to carry loads.
 - 2) Meet or exceed AASHTO HL-93 or interstate alternate loading according to AASHTO LRFD Bridge Design Specifications and interim specifications for pipe liner load capacity.
 - b. Maximum allowable external grouting pressure on pipe liner and joints for segmental thermoplastic and metal liners.
 - c. Certification that the pipe liner supplied will provide a minimum 75 year service life based on site characteristics such as soil resistivity, soil and water pH, and abrasion potential.
5. Mix Designs
 - a. Grout Mix design
 - b. Trial batch test data

PART 2 PRODUCTS

2.1 PVC FOLD-AND-FORM LINER

- A. PVC resin manufactured from virgin materials containing no fillers.
 1. Meet or exceed the physical property requirements in ASTM F 1504 or ASTM F 1871 for the cell classification as defined in ASTM D 1784.
- B. Do not use greater than 24 inch diameter.

2.2 CIPP LINER

- A. Fabric tube consisting of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, or fiberglass meeting the requirements of ASTM D 5813 and ASTM F 1216, ASTM F 1743, and ASTM F 2019.
 1. CIPP liner that meets or exceeds the following physical properties outlined in Table 1.

Table 1

Minimum Physical Properties		
Property	Test Method ASTM	Value
Initial Flexural Modulus	ASTM D 790	250,000 PSI @73° F
Flexural Strength	ASTM D 790	4,500 PSI @73° F

2. Use a sufficient quantity of resin for impregnation to fill the volume of air voids in the pipe liner with additional allowance for polymerization and for any migration of resin into the cracks and joints in the host pipe.
 - a. Color the resin with a pigment compatible with the resin system as specified by the resin manufacturer.

2.3 SEGMENTAL THERMOPLASTIC LINER

- A. Solid wall polyethylene pipe. Refer to AASHTO M 326.
- B. Profile wall thermoplastic pipe. Refer to Section 02610.

2.4 SEGMENTAL METAL LINER

- A. Refer to Section 02610.

2.5 GROUT

- A. Cementitious low density grout mixture having the following characteristics.
 1. Suitable with the site conditions, construction methods, and pipe liner structural capacity.
 2. Compressive strength between 100 and 400 psi
 - a. Determine strength from trial batches at 28 days
 3. Fluidity to completely fill voids and the annular space between the host pipe and the pipe liner without segregating
 4. Fly ash not to exceed 30 percent of cementitious material
 5. Shrinkage not to exceed 1 percent by volume

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish the type of drainage pipe liner shown with the following exception:
 - 1. Select from any of the drainage pipe liner products listed in this Section, Part 2 meeting the allowable pipe size reduction when no specific product is shown.

3.2 PREPARATION

- A. General
 - 1. Perform all work within the limits of the Department right of way unless written agreements are in place with adjacent property owners.
 - 2. Provide adequate control of water in the host pipe when necessary.
 - a. Repair damage caused as a result of flow control or lack thereof.
 - 3. Provide the necessary controls to prevent pollutants from being transported downstream.
- B. Host Pipe Cleaning
 - 1. Remove material to include sediment, rocks, and miscellaneous debris to inspection and install the pipe liner.
 - 2. Use a cleaning method and tools that will not cause damage to the pipe or surrounding roadway features.
 - a. Notify the Engineer when cleaning could result in damage.
 - b. Do not cause erosion of surrounding areas from cleaning operations.
 - c. Minimize sediment from being transported downstream.
 - 3. Collect and properly dispose of all material removed.
- C. Host Pipe Inspection
 - 1. Perform remote inspection for pipes with a nominal diameter less than 48 inches using a closed-circuit television (CCTV) crawler.
 - 2. Perform a visual inspection for pipes with diameter greater than 48 inches.

3. Inspect the condition of the host pipe and the suitability of the pipe liner installation. Document and notify the Engineer of the following:
 - a. Collapsed or impassable sections of the pipe
 - b. Horizontal or vertical alignment deviations
 - c. Structural concerns
 - d. Loss of material surrounding the pipe exterior
 - e. Infiltration of water
 - f. Repairs required to perform the installation
- D. Drainage Pipe Liner
 1. Verify host pipe internal size and length before ordering pipe liner.
 2. PVC fold-and-form and CIPP liner dimensions
 - a. Size the pipe liner to have an outside diameter that will tightly fit the inside of the host pipe.
 - b. Provide sufficient pipe liner length to continuously line the host pipe with no intermediate joints.
 3. Segmental Thermoplastic and Metal liner dimensions
 - a. Size the pipe liner to have an outside dimension that will freely pass through the host pipe and accommodate grout placement.
 - b. Use only one type of pipe liner and joint system in any single host pipe.

3.3 INSTALLATION

- A. General
 1. Remove sediment and debris that might have accumulated after the initial cleaning immediately before installing the pipe liner.
 2. Handle and install the pipe liner in a manner that will not cause damage to the pipe liner.
 3. Provide a smooth finish and a tight seal between the pipe liner and the drainage structure walls at pipe penetrations.
 4. Restore lateral and inlet connections.
 5. Inspect the rehabilitated pipe upon completion and before acceptance by the Engineer.
 - a. Evaluate pipe liners that contain dry spots, wrinkles, delamination, holes, cracks, joint gaps, soft spots, blisters, or other defects.

- B. PVC fold-and-form and CIPP Liner
 - 1. Meet minimum installation requirements according to ASTM F 1867 or ASTM F 1947 for PVC fold-and form
 - 2. Meet minimum installation requirements according to ASTM F 1216 or ASTM F 1743 for CIPP.
 - 3. Follow the manufacturer's recommended curing and relaxation period required to hold the pipe liner against the host pipe.
 - a. Provide sufficient gauges, monitoring devices, and tests to determine the effectiveness of the curing.
- C. Segmental Thermoplastic and Metal Liner
 - 1. Construct a bulkhead at each end of the host pipe to fully support the fluid thrust loads exerted by the placement of grout.
 - a. Vent bulkheads to allow release of trapped air as the grout flows into the annular space.
 - 2. Provide a minimum of 24 hrs for the pipe liner temperature to equalize within the host pipe before placing grout.
 - 3. Fill the entire full length of annular space between the host pipe and the pipe liner with grout.
 - a. Provide sufficient gauges, monitoring devices, and tests to determine the effectiveness of the grout placement.
 - 4. Do not exceed the pipe liner maximum specified grouting pressure.
 - a. Use a pumping unit with a pressure meter and valves capable of limiting grout pumping pressures to the maximum pressure recommended by the manufacturer at the end of the discharge pipe.
 - 5. Place grout in lifts to avoid excessive buoyant forces or grouting pressures.
 - a. Allow each lift to cure sufficiently before proceeding with next lift.
 - 6. Remove any internal braces or bands once the grout is sufficiently cured and before acceptance.

END OF SECTION

SECTION 02620

CONCRETE LINED PIPE INVERT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete lining for corrugated metal pipe invert.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete
- D. Section 03390: Concrete Curing

1.3 REFERENCES NOT USED

1.4 DEFINITIONS NOT USED

1.5 SUBMITTALS

- A. Include the following information into a single submittal for review for each drainage pipe to be lined. Use the naming convention used in the plans for each location. Divide information into the sections listed below.
 - 1. Work Area
 - a. Locations and dimensions of any temporary access roads
 - b. Locations and dimensions of work area "footprint"
 - c. Amount of time the footprint will be exposed
 - d. Written access agreements from property owners when work area is outside Department Right of Way
 - 2. Preparation
 - a. Host pipe cleaning
 - b. Management of flows in the host pipe
 - c. Initial pipe inspection
 - 3. Installation
 - a. Method of placing and finishing concrete
 - b. Curing method, identifying required curing times and temperatures

- c. Any potential for producing contaminant concentrations in excess of surface water quality standards or ambient groundwater quality standards as applicable
- d. Control and disposal of any contaminants from materials or installation methods during and after installation
- e. Final pipe inspection

PART 2 PRODUCTS

2.1 CONCRETE

- A. Concrete, Class AA(AE), Type V cement. Refer to Section 03055.
- B. Obtain approval from the Engineer for an alternate material.

2.2 WELDED WIRE REINFORCEMENT

- A. Galvanized welded wire reinforcement 6 x 6-W1.4 x W1.4. Refer to Section 03211.

PART 3 EXECUTION

3.1 PREPARATION

- A. General
 - 1. Perform all work within the limits of the Department right of way unless written agreements are in place with adjacent property owners.
 - 2. Complete backfill and embankment placement over the pipe before concrete lining.
 - 3. Provide adequate control of water in the host pipe when necessary.
 - a. Repair damage caused as a result of flow control or lack thereof.
 - 4. Provide the necessary controls to prevent pollutants from being transported downstream.
 - 5. Verify host pipe internal diameter and length before ordering concrete.
- B. Host Pipe Cleaning
 - 1. Remove material to include sediment, rocks, and miscellaneous debris in order that an inspection and concrete lining can be properly performed.

2. Use a cleaning method and tools that will not cause damage to the pipe or surrounding roadway features.
 - a. Notify the Engineer when cleaning could result in damage.
 - b. Do not cause erosion of surrounding areas from cleaning operations.
 - c. Minimize sediment from being transported downstream.
 3. Collect and properly dispose of all material removed.
- C. Host Pipe Inspection:
1. Perform a visual inspection
 2. Inspect the condition of the host pipe and the suitability of the concrete lined invert installation. Document and notify the Engineer of the following:
 - a. Collapsed or impassable sections of the pipe
 - b. Horizontal and vertical alignment deviations
 - c. Structural concerns
 - d. Loss of material surrounding the pipe exterior
 - e. Infiltration of water
 - f. Repairs required to perform the installation

3.2 PLACEMENT

- A. Shape and support the welded wire reinforcement to provide 1 inch clearance from the crest of the metal corrugations.
- B. Place concrete at least 4 inches above the crest of the corrugations and to a width one third of the circumference of a round pipe or the maximum span of an arch pipe.
 1. Control the thickness of the concrete by installing non-corrosive pins, nails, or other gauging devices into the crest of the corrugations, perpendicular to the surface.
- C. Finish the concrete to a floated surface finish according to Section 03310.
- D. Cure concrete according to Section 03390.
 1. Provide a minimum of 48 hours before allowing water to flow through the pipe after applying the curing compound.

END OF SECTION

SECTION 02622

PIPE UNDERDRAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe underdrains.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02075: Geotextiles
- C. Section 02317: Structural Excavation
- D. Section 02633: Concrete Drainage Structures

1.3 REFERENCES

- A. AASHTO M 252: Corrugated Polyethylene Drainage Pipe
- B. AASHTO M 278: Class PS46 Poly (Vinyl Chloride) (PVC) Pipe
- C. AASHTO M 294: Corrugated Polyethylene Pipe, 300-to 1500-mm (12- to 60-in.) Diameter
- D. AASHTO M 304: Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
- E. AASHTO M 330: Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
- F. AASHTO PP 63: Pipe Joint Selection for Highway Culvert and Storm Drains
- G. AASHTO National Transportation Product Evaluation Program (NTPEP)

1.4 DEFINITIONS

- A. Profile Wall Pipe – A pipe that has a smooth interior wall with an exterior that is either is ribbed, corrugated, or smooth. The wall may contain hollow cores.

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and installation instructions for information.
- B. Documentation from AASHTO NTPEP showing compliance with Table 1 for the pipe material and diameter supplied for information.

PART 2 PRODUCTS

2.1 PIPE

- A. Thermoplastic profile wall pipe having perforations around the entire circumference meeting the material requirements shown in Table 1.

Table 1

Perforated Pipe Material Specifications	
Material Type	AASHTO Specification
High Density Polyethylene (HDPE)	M 252, M 294
Polyvinyl Chloride (PVC)	M 278, M 304
Polypropylene	M 330

- B. Soil tight pipe joints according to AASHTO PP 63.
- C. Pipe fittings matching the pipe material type.

2.2 DRAINAGE GEOTEXTILE

- A. Refer to Section 02075.

2.3 FREE DRAINING GRANULAR BACKFILL

- A. Refer to Section 02056.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavate a trench to a width of the outside pipe diameter plus 2 ft and to a depth of 3 inches below the bottom of the pipe.
 - 1. Refer to Section 02317.
 - 2. Keep trenches free of water.

- B. Grade and prepare the bottom of the trench to provide a firm and uniform bearing surface.
- C. Place drainage geotextile within the trench as shown.
- D. Place and compact the bottom 3 inches of the trench with free draining granular backfill.
- E. Connect pipes to concrete drainage structures according to Section 02633.
 - 1. Place an end cap at the upstream end of the pipe when not connected to a structure.
- F. Place and compact the remainder of the free draining granular backfill to depth shown.

END OF SECTION

SECTION 02624

APPROACH SLAB CATCH BASIN MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drainage catch basin in the approach slab of an existing structure.

1.2 RELATED SECTIONS

- A. Section 02633: Concrete Drainage Structures
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03310: Structural Concrete
- E. Section 03575: Flowable Fill

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 270: Structural Steel for Bridges
- C. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- D. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete, Class AA(AE). Refer to Section 03055.
- B. Coated reinforcing steel. Refer to Section 03211.
- C. Structural Steel
 - 1. Refer to AASHTO M 270, Grade 36.
 - 2. Galvanize after fabrication. Refer to AASHTO M 111.
- D. Flowable Fill. Refer to Section 03575.

PART 3 EXECUTION

3.1 PREPARATION

- A. Location
 - 1. Adjust catch basin location for better drainage performance where necessary as directed by the Engineer.
 - a. Mark location in the presence of the Engineer.
- B. Concrete Removal
 - 1. Make saw cuts 1 inch deep to define the work areas.
 - 2. Remove concrete using 90 lb class, hand-operated jackhammers or smaller.
- C. Reinforcing Steel
 - 1. Cut steel encountered during concrete removal operations so that the final catch basin opening is unencumbered as shown on the plans.
 - 2. Expose a minimum of 10 inches of reinforcing steel in both the bottom and upper mats of the existing approach slab on at least three sides of the new catch basin location.
 - 3. Repair the surface of damaged rebar before placing concrete.
 - a. Epoxy coating repair – Refer to ASTM D 3963.
 - b. Galvanized rebar repair – Refer to ASTM A 780.
- D. Excavation
 - 1. Excavate sufficient material to construct the catch basin to the required size and depth.

3.2 CONSTRUCTION

- A. Construct catch basin as shown.
 - 1. Cast-in-place or precast elements may be used. Refer to Section 03310.
 - 2. Tie the new catch basin reinforcing steel to the exposed reinforcing steel of the existing approach slab.
- B. Provide for proper outlet connection to the pipe in the side of the catch basin. Refer to Section 02633.
- C. Fill excavated voids not occupied by the new catch basin with flowable fill, or alternate, as approved by the Engineer.

END OF SECTION

SECTION 02625

APPROACH SLAB DRAIN FRAME MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricate and install a frame riser to raise the existing approach slab drain grate to match the grade of the asphalt surfacing.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 270: Structural Steel for Bridges

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Use structural steel plates according to AASHTO M 270, Grade 36.
- B. Galvanize the frame riser after fabrication as specified. Refer to AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify plan dimension for the existing grate system before fabricating the new frame riser.

3.2 INSTALLATION

- A. Construct the frame riser as shown.
- B. Place a new frame riser before placing asphalt surfacing.
 - 1. Plate compact the asphalt surfacing and slope the asphalt surfacing in the areas surrounding the frame of the drain.
- C. Position the grate properly to receive the water flow. Line up grate ribs with water flow for square or rectangular frames.

3.3 CLEANING

- A. Clean all debris and trash from the drain basin and grate ribs.

END OF SECTION

SECTION 02626

DECK DRAIN MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Frame riser to raise the existing drain grate to match the grade of the asphalt surfacing.
- B. Deck drain pipe extension.
- C. Deck drain closure.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 05120: Structural Steel

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 235: Epoxy Resin Adhesives
- C. AASHTO M 270: Structural Steel for Bridges
- D. AASHTO/AWS D1.5 Bridge Welding Code
- E. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- F. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Materials
 - 1. Mill Test Report (MTR) for all structural steel.
 - a. Provide item number and name on all material submittals.
 - b. Refer to Section 05120.

2. Manufacturer's AISC Simple Steel Bridge Structure (SBR) certificate.
3. Welding procedure specifications meeting AASHTO/AWS D 1.5.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Galvanize the frame riser, extension pipe, and any required attachment hardware after fabrication according to AASHTO M 111.
- B. Use structural steel plates according to AASHTO M 270, Grade 36.
- C. Use steel pipes according to ASTM A 53, Grade B.

2.2 ANCHOR BOLTS

- A. Refer to ASTM F 1554.

2.3 FABRICATION

- A. Refer to AASHTO/AWS D1.5.

2.4 ADHESIVE FOR DOWELED ANCHORS

- A. Refer to AASHTO M 235 for epoxy resin adhesive.
 1. Type IV, Grade 3, and Class C

2.5 CONCRETE

- A. Class AA (AE) concrete, unless specified otherwise. Refer to Section 03055.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify plan dimensions for the existing grate system before fabricating the new frame riser.
- B. Verify location and dimensions of the existing deck drain system before fabricating the new drain pipe and fittings.

3.2 INSTALLATION

- A. Deck Drain Modification
 1. Construct the frame riser.
 2. Place a new frame riser before placing asphalt surfacing. Plate compact the asphalt surfacing and slope the asphalt surfacing in the areas surrounding the frame of the drain.
 3. Position the grate properly to receive the water flow. Line up grate ribs with water flow for square or rectangular frames.
- B. Deck Drain Pipe Extension
 1. Construct steel pipe drainage system as shown.
 2. Connect steel pipes to existing deck drains.
 - a. Provide continuous weld around perimeter of pipe connection so that no water can escape through the connection.
 3. Fasten steel pipe to the abutment or bent as shown.
 - a. Dowel and epoxy anchor bolts into concrete with a minimum embedment of 4 inches.
 - b. Prior to dowelling locate existing rebar by means of a non-destructive scan.
 - c. Field adjust anchor bolt locations to avoid reinforcing steel.
- C. Deck Drain Closure
 1. Use a steel plate with a minimum thickness of $\frac{3}{8}$ inch or a concrete plug as shown before placing new asphalt surfacing.

3.3 CLEANING

- A. Clean all debris and trash from the drain basin and grate ribs.

END OF SECTION

SECTION 02633

CONCRETE DRAINAGE STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for constructing concrete drainage structures from the CB and DB Series Standard Drawings.

1.2 RELATED SECTIONS

- A. Section 01721: Survey
- B. Section 02056: Embankment, Borrow, and Backfill
- C. Section 02635: Grates, Solid Covers, Frames, and Manhole Steps
- D. Section 03055: Portland Cement Concrete
- E. Section 03056: Self-Consolidating Concrete (SCC)
- F. Section 03152: Concrete Joint Control
- G. Section 03211: Reinforcing Steel and Welded Wire
- H. Section 03310: Structural Concrete
- I. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 198: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- B. AASHTO M 199: Precast Reinforced Concrete Manhole Sections
- C. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- D. AASHTO M 235: Epoxy Resin Adhesives

- E. AASHTO M 315: Joints for Concrete Pipes and Manholes Using Rubber Gaskets
- F. AASHTO Standard Specification for Highway Bridges – current edition
- G. ASTM C 361: Reinforced Concrete Low-Head Pressure Pipe
- H. ASTM C 443: Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- I. ASTM C 478: Precast Reinforced Concrete Manhole Sections
- J. ASTM C 857: Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- K. ASTM C 858: Underground Precast Concrete Utility Structures
- L. ASTM C 891: Installation of Underground Precast Concrete Utility Structures
- M. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- N. ASTM C 1244: Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
- O. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Catch Basin/Drop Inlet – A structure accepting drainage from gutters or medians or other channels and discharging the water through a conduit. Refer to the CB and DB Series Standard Drawings for shape and dimensions of Standard Catch Basins.
- B. Inlet – A grated surface connection to a closed conduit such as a storm drain. A structure at the upstream end of a cross culvert. The upstream end of any structure through which water may flow.
- C. Manhole (access hole) – A circular structure for access and joining pipes. Refer to the CB Series Standard Drawings for the Standard Detail for a Manhole.

1.5 SUBMITTALS

- A. Concrete mix design for approval according to Section 03055 or 03056.
- B. Precast Structures
 - 1. Provide verification the structures are furnished by a Department pre-qualified precast supplier.
 - 2. Submit a Certificate of Compliance from Department Central Materials upon delivery to the project.
- C. Repair Procedure
 - 1. Submit to the Engineer for approval before performing any repairs. Refer to this Section, Article 1.6, paragraph B.

1.6 ACCEPTANCE

- A. Select and construct or install cast-in-place precast drainage structures according to this Section.
 - 1. Cast in place construction.
 - 2. Precast construction.
 - a. Field verify the fit and function at structure locations before manufacturing.
 - b. The Department will not reimburse the Contractor for precast structures that do not fit existing field conditions.
- B. Repair or replace any structure that has the following:
 - 1. Fractures or cracks passing through the wall except for a single end crack that does not exceed the thickness of the precast unit.
 - 2. Defects showing improper proportioning, mixing, or molding.
 - 3. Honeycombing and open texture.
 - 4. Damaged or cracked ends that prevent joining manhole or inlets grade rings and sections.
 - 5. Any continuous crack with a surface width of 0.01 inch or more that extends more than 12 inches anywhere on the wall.
 - 6. Limit cracks or fractures for grade rings or similar structures. Refer to ASTM C 478.
- C. Precast Structures
 - 1. Furnish precast drainage structures according to the CB Series Standard Drawings.
 - a. Pre-qualify the supplier according to the UDOT Quality Management Plan – Precast/Prestressed Concrete Structures.
 - b. Furnish precast structures that are plumb and square within $\frac{1}{8}$ inch per foot so that precast adjoining elements fit.

- c. Mark structures with date of casting and supplier identification.
- D. Obtain acceptance from the Engineer upon completing each installation and before placing backfill.
 - 1. Verify the structures and pipe connections appear watertight.
 - 2. Test according to this Section, Article 3.3 when directed by the Engineer.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Wet cast – Class AA(AE). Refer to Section 03055.
- B. Dry cast – Submit mix design for approval.
 - 1. Minimum cement content 470 lb/yd³
 - 2. Maximum water/cementitious ratio 0.40
- C. Self-Consolidating Concrete – Refer to Section 03055.

2.2 REINFORCING STEEL AND WELDED WIRE

- A. Refer to Section 03211.

2.3 STRUCTURAL CONCRETE

- A. Refer to Section 03310.

2.4 JOINTS AND SEALERS

- A. Preformed Joint Filler. Refer to AASHTO M 213 and AASHTO M 198.

2.5 WATERSTOPS

- A. Refer to Section 03152 for materials requirements.
- B. Refer to AASHTO Standard Specification for Highway Bridges, Division II, sub-section 8.9.3.4 for installation requirements.

2.6 NON-SHRINK GROUT

- A. Use non-shrink grout according to ASTM C 1107.

2.7 FORMS

- A. Use plywood, wood, metal, glass, or a combination of these materials.

2.8 GASKETS AND JOINT SEALANTS FOR CONNECTING PRECAST SECTIONS

- A. Furnish gaskets for sealing precast sections that meet ASTM C 443 requirements.
- B. Furnish gaskets for sealing precast concrete manholes that meet AASHTO M 315.
- C. Furnish epoxy resin adhesive. Refer to AASHTO M 235.
- D. Furnish "O" Ring according to ASTM C 361 as shown in the CB Series Standard Drawings.

2.9 MANHOLE/FRAME GASKET

- A. Place $\frac{3}{4}$ inch diameter minimum extruded rope Type B flexible plastic gaskets between the manhole frame and the concrete risers according to AASHTO M 198 requirements.

2.10 JOINTING MASTIC

- A. Furnish water-resistant elastic jointing mastic of plastic bituminous materials and inert fillers that do not lose slump or plasticity when applied to a vertical metal surface and heated to 120 degrees F.
- B. Furnish joint mastic that can be applied evenly and adhere at temperature range of 40 to 120 degrees F or higher.

2.11 GRATES, SOLID COVERS, FRAMES, AND MANHOLE STEPS

- A. Refer to Section 02635.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify fit and function with field conditions before manufacturing or constructing any structure. Refer to Section 01721.

- B. Furnish structures free of voids, cracks, and with beveled corners and edges. Securely attach all inserts in the proper location.
 - 1. Prevent cold joints in the structure.
- C. Clean and prepare the mating surfaces before assembly of pipes with structure.
 - 1. Use one of the following methods to connect the pipes to the structure for precast:
 - a. Pipe boot according to pipe manufacturer specifications for pipe type.
 - b. Non-shrink grout to seal the pipe connection.
- D. Excavate the material under the box location to a minimum depth of 4 inches and backfill with suitable backfill material and compact.
 - 1. Excavate sufficiently to place and compact bedding and backfill material according to Section 02056.
 - 2. Add as needed, a sand-leveling course no greater than 2 inches in depth to the backfill material.
 - a. Excavate the area to the appropriate depth to accommodate the backfill and leveling course, when used.

3.2 INSTALLATION

- A. Manholes
 - 1. Furnish precast concrete manholes according to ASTM C 478 and use self-centering watertight joints that meet ASTM C 443. Refer to CB Series Standard Drawings.
 - a. Cure wet cast members according to Section 03390.
- B. Grade Rings/Catch Basin Grade Sections
 - 1. Furnish according to ASTM C 478 with anchor bolt-holes as shown on the CB Series Standard Drawings.
 - a. Cure wet cast members according to Section 03390.
- C. Precast Inlets and Boxes
 - 1. Furnish structures according to CB Series Standard Drawings.
 - a. Attach and secure all inserts at the place of manufacture such as wall sleeves, gaskets or piping, sumps, steps, access hatches, and any other inserts as shown on CB Series Standard Drawings.
 - 2. Manufacture structures according to applicable requirements of ASTM C 858 and as modified by this Section.
 - a. Meet AASHTO M 199 and ASTM C 857 requirements.
 - b. Cure wet cast members according to Section 03390.
 - 3. Provide sufficient lifting points for a safe installation.

- a. Locate lifting devices to avoid interference with the reinforcing steel.
- 4. Do not ship precast units until after 28-day compressive strength has been attained.
 - a. Protect the unit from any damage.
- 5. Refer to ASTM C 891. Comply with manufacturer installation guidelines.
 - a. Inspect precast drainage structures for defects before lowering into excavation.
 - b. Clean mating surfaces of all foreign materials such as dirt, mud, and stones and apply proper joint sealing material where applicable.
 - c. Assemble all joints tightly.
 - d. Use care when joining precast elements in cold weather. Do not force joints together with mechanical equipment.
 - e. Sufficiently warm all sealing materials to flow without causing damage to precast joint elements.
- 6. Furnish structures with appropriate openings for connecting pipe.
 - a. Cast or cut structure openings. Do not expose reinforcing steel or reduce reinforcing steel covering at openings.
 - b. Do not modify precast units in the field by cutting or enlarging holes or by making any other changes without the manufacturer's and Engineer's approval.
 - c. Modify precast units only according to manufacturer requirements.
- 7. Do not place precast drainage structure in excavation that has water and frozen surfaces.
- 8. Plug lift insert recesses with a 1:1 sand to cement grout mix.
 - a. Finish flush with top, bottom, or both surfaces of concrete.
- D. Cast-in-place concrete drainage structures.
 - 1. Refer to CB and DB Series Standard Drawings.
 - 2. Construct according to Section 03310.
 - 3. Cure according to Section 03390.

3.3 TESTING

- A. Conduct either a vacuum test or ex-filtration test to verify the drainage structures are watertight at the direction of the Engineer upon failure of the visual inspection referenced in this Section, Article 1.6.
 - 1. Furnish all necessary equipment and materials for repair and re-test any structures that fail any tests.
 - 2. Do not conduct vacuum and ex-filtration tests concurrently.

- B. Vacuum Test – Follow the test procedure outlined below:
1. Vacuum test precast structures after assembly and before backfilling.
 - a. Form a seal between the vacuum base and the manhole rim/precast structure cover. Secure pipe plugs to prevent movement while the vacuum is drawn.
 - b. Draw a vacuum of 10 inches of mercury (Hg). Record the time for the vacuum to drop to 9 inches.
 - c. Passing drop rates for the time to drop to 9 inches are:

<u>Diameter/Width</u>	<u>Time to Drop 1 inch Hg</u>
up to 4 ft	30 seconds
4 ft and larger	40 seconds
 - d. Make necessary repairs if the structure fails the test. Repairs and repair procedures must be acceptable to the Engineer.
 - e. Disassemble the manhole and replace the gaskets if preformed plastic gaskets are pulled out during the vacuum test.
- C. Ex-filtration Test – Follow test procedure ASTM C 1244 as modified below:
1. Plug all pipes leading into or out of the precast structure for a watertight seal.
 2. Fill precast structure with water to a level 3-4 inches below the casting rim or lid.
 3. Let the water stand for two hours before beginning the test to allow absorption into the precast structure.
 4. Place additional water to bring the water level back to 3-4 inches below the rim or lid after the two hour stabilization.
 5. Test for at least two hours and verify the leakage is less than shown on table 1.

Table 1

Precast Structure Ex-Filtration Test – Allowable Leakage						
Water Depth (measured from invert to water level)	Allowable water drop per hour					
Feet	Maximum Horizontal Internal Dimension					
	4 ft.*		5 ft *		6 ft *	
	(gals)	(inches)	(gals)	(inches)	(gals)	(inches)
2	0.8	0.32	1.0	0.40	1.2	0.48
4	1.6	0.64	2.0	0.8	2.4	0.96
6	2.4	0.96	3.0	1.21	3.6	1.45
8	3.2	1.29	4.0	1.61	4.8	1.93
10	4.0	1.61	5.0	2.01	6.0	2.42
12	4.8	1.93	6.0	2.42	7.2	2.90
14	5.6	2.25	7.0	2.82	8.4	3.38
16	6.4	2.58	8.0	3.22	9.6	3.87
18	7.2	2.90	9.0	3.63	10.8	4.35
20**	8.0	3.22	10.0	4.03	12	4.84
* Adjust volume loss proportionally for different size not shown						
** Provide an engineering analysis for equivalent ex-filtration rates for depths greater than 20 feet.						

- D. The Department will reimburse the Contractor for the actual cost of each test required by the Engineer to meet vacuum or ex-filtration requirements, not to exceed \$500 per test.

END OF SECTION

SECTION 02635

GRATES, COVERS, FRAMES, TRASH RACKS, AND MANHOLE STEPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grates, covers, frames, trash racks and manhole steps.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- C. AASHTO M 199: Precast Reinforced Concrete Manhole Sections
- D. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
- E. AASHTO M 306: Drainage, Sewer, Utility, and Related Castings
- F. ASTM D 4101: Polypropylene Injection and Extrusion
- G. AWS D1.1: Structural Welding Code - Steel

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Shop drawings for cast iron alternative to steel grates and frames, for review.
- B. Manhole step manufacturer's product data sheets and installation instructions for information.

PART 2 PRODUCTS

2.1 GRATES, COVERS, FRAMES, AND TRASH RACKS

- A. Refer to the DB and GF Standard Series Drawings.
 - 1. Structural Steel
 - a. AASHTO M 270, Grade 36.
 - b. Hot-dip galvanize after fabrication according to AASHTO M 111.
 - c. Fabricate according to AWS D1.1
 - 2. Grey Iron.
 - a. AASHTO M 306, Class 35B.
 - 3. Ductile Iron.
 - a. AASHTO M 306, Grade 60 or greater.

2.2 MANHOLE STEPS

- A. Refer to AASHTO M 199 and GF Standard Series Drawings.
 - 1. Steel Rod
 - a. AASHTO M31, Grade 60.
 - 2. Copolymer Polypropylene Plastic
 - a. ASTM D 4101.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide a firm and even bearing surface on the frame so that the grate or cover will not rock under the influence of loading.
- B. Cast manhole steps into the concrete structure wall or install according to manufacturer's instructions.

END OF SECTION

SECTION 02645

PRECAST CONCRETE BOX AND THREE-SIDED CULVERT STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single-cell precast concrete box culverts, multi-cell precast concrete box culverts, and precast concrete three-sided structures as shown.
- B. Precast or cast-in-place secondary elements such as cutoff walls, aprons, footings, floor slabs, headwalls, and wingwalls as shown.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02317: Structural Excavation
- C. Section 03055: Portland Cement Concrete
- D. Section 03211: Reinforcing Steel and Welded Wire
- E. Section 03310: Structural Concrete
- F. Section 03390: Concrete Curing
- G. Section 03575: Flowable Fill
- H. Section 07105: Waterproofing Membrane

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
- C. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

- D. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
- E. AASHTO LRFD Bridge Design Specifications
- F. AASHTO Manual for Bridge Evaluation
- G. ASTM C 877: External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
- H. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
- I. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- J. ASTM C 990: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- K. ASTM C 1504: Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains
- L. ASTM C 1577: Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
- M. Precast/Prestressed Concrete Institute (PCI) Design Handbook
- N. UDOT Bridge Management Manual
- O. UDOT Quality Management Plan
- P. UDOT Structures Design and Detailing Manual (SDDM)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Fabrication and installation drawings for review of all fabricated materials, and cast-in-place elements that are included in this item of work and are not detailed in the contract plans.
 - a. Include details not provided in the contract documents for the fabrication, transportation, erection, and construction of the members included in this item of work.

- b. Detail all phases of construction including layout, joint details, lifting devices, casting methods, construction placement, and details of any cast-in-place elements included in this item of work.
- c. Note proposed transportation methods.
- d. Include inventory and operating load ratings in a table on the first sheet of the drawings for structures with spans greater than 20 ft.
 - 1) Measure span length along roadway centerline.
- e. Load Rating Report and supplemental documentation according to the AASHTO Manual for Bridge Evaluation and the UDOT Bridge Management Manual when load rating is required.
- f. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah on the drawings and supporting engineering calculations for the following:
 - 1) Special designs of precast concrete box culverts designed by the fabricator.
 - 2) Precast concrete three-sided structures.
 - 3) Lifting devices.
 - 4) Structural members and ancillary appurtenances designed by the fabricator.
 - 5) Connections between precast and cast-in-place members and appurtenances.
 - 6) Load ratings.
 - 7) Any other means and methods that require an engineer's design.

- B. Dry Cast Concrete
 - 1. Certificate of Compliance.

- C. Structural Non-Shrink Grout
 - 1. Certificate of Compliance.

1.6 ACCEPTANCE

- A. Precast concrete box culverts and precast concrete three-sided structures may be accepted at a reduced price when the concrete strength is below that specified.
 - 1. Price adjustment pay factor according to Section 03055.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Wet Cast Concrete – Class AA(AE). Refer to Section 03055.
- B. Dry Cast Concrete
 - 1. Minimum cement content 470 lb/yd³ of concrete.
 - 2. Meet specified 28 day minimum compressive strength.

2.2 REINFORCING STEEL AND WELDED WIRE

- A. Coated – Refer to Section 03211.

2.3 JOINT SEALANT

- A. Refer to ASTM C 990.
- B. Use a flexible butyl rubber material with a minimum cross-section of $\frac{3}{4}$ x 1½ inches as a joint sealant for box culverts.
- C. Joint sealant furnished by culvert manufacturer.

2.4 JOINT WRAP

- A. Refer to ASTM C 877.

2.5 WATERPROOFING MEMBRANE

- A. Refer to Section 07105.

2.6 STRUCTURAL NON-SHRINK GROUT

- A. Use gray, non-shrink grout containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
- B. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
- C. Meet all the requirements of AASHTO T 160 with the exception that the Contractor-supplied cube molds will remain intact with a top firmly attached throughout the curing period.
- D. Mix structural non-shrink grout just before use according to the manufacturer's instructions.

- E. Refer to Table 1 for additional structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
*Properties	Requirements	ASTM	AASHTO
Accelerated Weathering: Tested Medium Accepted Weight Loss	<3% White Utah Road Salt <15% @ 300 Cycles		T 161
Compressive Strength	>3,000 psi @ 24 hours >5,000 psi @ 7 days		T 106
Accepted Bond Strength	>1,000 psi @ 24 Hours	C 882 as modified by C 928 8.5	
Length Change	No expansion after 7 days		T 160

* Certified test results from an independent AASHTO accredited testing laboratory are acceptable.

2.7 LIFTING DEVICES

- A. Use lifting devices that can support the required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements of the PCI Design Handbook.
- B. Galvanize according to AASHTO M 111.

2.8 GROUTED SPLICE COUPLERS

- A. Refer to Section 03211.

2.9 GRANULAR BACKFILL BORROW

- A. Refer to Section 02056.

2.10 FREE DRAINING GRANULAR BACKFILL

- A. Refer to Section 02056.

2.11 FLOWABLE FILL

- A. Refer to Section 03575.

2.12 MANUFACTURE

- A. Use a Department Certified Concrete Precaster for precast concrete box culverts and three-sided structures according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.
- B. Precast Concrete Box Culverts
 - 1. Refer to ASTM C 1577, except as modified by this Section.
 - 2. Provide the design of special designs for sizes and loads other than those shown in Table 1 of ASTM C 1577 if the design is not provided.
 - 3. Prepare special designs according to AASHTO LRFD Bridge Design Specifications, Section 12 and the SDDM.
 - 4. Provide 1 inch minimum concrete cover to reinforcing steel bars.
 - 5. Provide minimum concrete cover to reinforcement where welded wire fabric is used, equal to the greater of three times the diameter of the wire or 1 inch.
 - 6. Provide 2 inch minimum concrete cover to the reinforcing steel in the top of the top slab of box sections covered with less than 2 ft of fill for all types of reinforcement.
 - 7. Provide tongue and groove ends or equivalent to transfer shear between sections at all joints.
 - 8. Design and form section ends so that the sections can be laid together to make a continuous line of box sections compatible with the permissible variations in Section 11 of ASTM C 1577.
- C. Precast Concrete Three-Sided Structures
 - 1. Refer to ASTM C 1504 with the following exceptions:
 - a. Design the structure according to AASHTO LRFD Bridge Design Specifications, Section 12.
 - b. Design for HL-93 live loading.
 - 2. Provide a maximum longitudinal wire spacing of 8 inches for welded wire. Provide a circumferential wire spacing not greater than 4 inches or less than 2 inches.
 - 3. Provide minimum concrete cover to welded wire fabric equal to the greater of three times the diameter of the wire or 1 inch.
 - 4. Provide 2 inch minimum concrete cover to all reinforcing steel in the top of the top slab for three-sided structures covered by less than 2 ft of fill.
- D. Project the reinforcing steel at least 12 inches out of the precast sections and square off the concrete face where precast sections join cast-in-place concrete.

- E. Provide the number and type of lifting devices required to support the vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements of the PCI Design Handbook.
 - 1. Use a maximum diameter of 3 inches when lifting holes are used.
 - 2. Locate holes to avoid interference with the reinforcing steel.
- F. Do not locate horizontal and vertical changes in alignment greater than 10 degrees at a joint between precast segments of a precast concrete box culvert unless otherwise approved by the Engineer.
- G. Permanently mark each precast unit with date of casting and supplier identification.
- H. Cast the Department structure number into the top and exposed faces of the headwall at each end of the structure as shown.
- I. Concrete Curing – Refer to Section 03390.
- J. Do not use precast segments less than 5 ft in lay length.

2.13 QUALITY ASSURANCE

- A. Precast Elements
 - 1. Prevent cracking or damage of precast elements during shipping, handling, and storage.
 - 2. Replace defects and breakage of precast elements.
 - a. Members that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review or rejection.
 - b. Obtain approval before performing repairs.
 - c. Repair work must reestablish the elements' structural integrity, durability, and aesthetics to the satisfaction of the Engineer.
 - d. Determine the cause when damage occurs and take corrective action.
 - e. Failure to take corrective action, leading to similar repetitive damage, can be cause for rejection of the damaged element.
 - f. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection.
 - g. Full depth cracking and breakage greater than 1 ft are cause for rejection.

3. Document all test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of cast
 - c. Concrete cylinder test results
 - d. Quantity of used concrete and the batch printout
 - e. Form-stripping date and repairs if applicable
 - f. Location/number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period
 - h. Lifting device details, requirements, and inserts

PART 3 EXECUTION

3.1 EXCAVATING, TRENCHING, BEDDING, AND BACKFILL

- A. Refer to Section 02317.
- B. Excavate to at least 6 inches below the bottom of the precast structure or as shown.
- C. Scarify, and moisture condition, and compact the top 8 inches of the excavated ground surface to at least 90 percent of the maximum dry density.
- D. Place a bedding of at least 6 inches of granular backfill borrow or as shown.
 1. Level and compact bedding material to provide uniform support of the structure along its entire supported width and length.
 2. Limit the soil gradation for granular backfill borrow used as bedding under precast members to 100 percent passing the $\frac{3}{4}$ inch sieve.
 3. Modify the soil gradation for free draining granular backfill used as bedding under precast members to 100 percent passing the $\frac{3}{4}$ inch sieve.
- E. Backfill structure as shown.
- F. Refer to the authorized fabrication and installation drawings for excavation, bedding, and backfill requirements where a precast three-sided structure is placed on a footing.
- G. Fill the gap between multiple single cell culverts with flowable fill as shown.

3.2 INSTALLATION

- A. Inspect precast elements for defects before lowering into trench.
- B. Repair or replace defective, damaged, or unsound precast elements.
- C. Use a trench width adequate to place and compact bedding material.
 - 1. Minimum outside width of trench is the outside width of structure plus 2 ft each side.
- D. Lay precast elements starting at the downstream end.
- E. Carefully lower precast elements into the trench with suitable equipment to prevent damage.
- F. Remove all dirt and foreign material from joints.
- G. Apply joint sealant to precast box culvert.
 - 1. Place the joint sealant material on the bottom half of the groove (bell) of the box last placed.
 - 2. Place the balance of the joint sealant material on the top half of the tongue (spigot) of the box to be set.
 - 3. Place the joint sealant material about 1 inch from the leading edge of the groove and tongue.
 - 4. Maintain the joint sealant material at 70 degrees F or greater during placement.
- H. Pull precast box culvert sections together to $\frac{1}{2}$ inch joint gap spacing measured face to face of adjoining concrete surfaces with the joint gap being uniform on all sides of the precast box culvert.
 - 1. Use appropriate pulling devices to avoid misalignment and damage to box sections.
 - 2. The Engineer may approve up to a $\frac{3}{4}$ inch joint gap spacing in cases where it is necessary to adjust the total length of a box culvert run.
 - 3. Reject box sections when the installation tolerance cannot be met due to casting variations.
 - 4. Prevent soil from being forced into the joint as the box sections are placed.
 - 5. Disassemble joint, check position of joint sealant, repair alignment, and re-install when adjoining elements cannot be pulled together to meet joint requirements.
- I. Do not disturb previously completed joints during laying operation.

- J. Do not lay precast elements when water is in the trench.
- K. Place precast three-sided structure sections against previous sections as tightly as possible while maintaining alignment.
 - 1. Follow manufacturer's installation recommendations.
 - 2. Do not exceed joint tolerances in the authorized fabrication and installation drawings.
- L. Apply joint wrap to the top slab and side walls at all joints.
 - 1. Clean top and sides of concrete surface at joints before placing joint wrap.
 - 2. Use a minimum width of 2 ft centered on the joint.
- M. Install precast cutoff walls, aprons, wingwalls, and headwalls, as follows:
 - 1. Establish working points, working lines, and benchmark elevations before placing elements.
 - 2. Clean bonding surfaces between elements of debris, dust, and rust before connecting elements to achieve the required bonding between protruding bars and elements.
 - 3. Place cut-off wall and apron elements as shown in the plans.
 - a. Adjust the final location of the cut-off wall or apron elements if actual joint gaps cause the final location to vary.
 - b. Adjust the height of each apron element by means of leveling devices or shims.
 - 4. Lift apron segments using lifting devices as shown on the authorized fabrication and installation working drawings.
 - 5. Set elements in the proper horizontal location. Check for proper alignment and grade within specified tolerances.
 - 6. Adjust vertical leveling devices before full release of the apron from the crane to reduce the amount of torque required to turn the bolts in the leveling devices. Check for proper grade within specified tolerances.
 - 7. Place or pump flowable fill into voids and pockets as shown.

3.3 JOINTS

- A. Mechanically connect the exterior sections of precast three-sided structures at all top joints within a minimum length of 12 ft from each end of the structure.
 - 1. Use at least four mechanical connections per joint with a maximum spacing of 10 ft.
 - 2. Galvanize all plates, shapes, and hardware.

- B. Connect precast three-sided structures to the footing, pedestal, or slab 2 ft from the outermost exterior edge of the structure at all four corners of the structure with a galvanized rigid mechanical connection.
 - 1. Locate the connection on the interior face of the segment to allow for future inspection.

3.4 LIFTING HOLES AND DEVICES

- A. Plug lifting holes and lifting device recesses with structural non-shrink grout.
 - 1. Finish flush with all concrete surfaces.

3.5 CAST-IN-PLACE CONCRETE

- A. Refer to Section 03310.

3.6 WATERPROOFING MEMBRANE

- A. Apply a waterproofing membrane to the top slab and side walls of concrete box culverts and three-sided structures for the full length of the structures.

END OF SECTION

SECTION 02701

PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acceptance testing and determination of a minimum International Roughness Index (IRI) for pavement smoothness of Hot Mix Asphalt (HMA), Open Graded Surface Course (OGSC), Bonded Wearing Course (BWC), Stone Matrix Asphalt (SMA), and Portland Cement Concrete Pavement (PCCP) rehabilitation using a profiler, approved and certified by the Department.
- B. Application of Incentive/Disincentive for pavement smoothness.

1.2 RELATED SECTIONS

- A. Section 02742S: Project Specific Surfacing Requirements
- B. Section 02748: Prime Coat/Tack Coat
- C. Section 02981: Grinding Pavement

1.3 REFERENCES

- A. AASHTO M 328: Inertial Profiler
- B. AASHTO R 43: Quantifying Roughness of Pavements
- C. AASHTO R 54: Accepting Pavement Ride Quality When Measured Using Inertial Profiling Systems
- D. AASHTO R 57: Operating Inertial Profiling Systems
- E. ASTM E 2560: Standard Specification for Data Format for Pavement Profile
- F. UDOT Materials Manual of Instruction

1.4 DEFINITIONS

- A. Category 1 Pavements
 - 1. Newly constructed pavement surfaces having two or more opportunities for improving ride.
- B. Category 2 Pavements
 - 1. Newly constructed pavement surfaces without two or more opportunities for improving ride.
- C. Opportunity to Improve Ride
 - 1. Placing Granular Borrow, Untreated Base Course, Treated Base Course, Open-Graded Surface Course (OGSC), Bonded Wearing Course (BWC), Stone Matrix Asphalt (SMA), Cold-In-Place Recycling, Hot-In-Place Recycling, and each lift of paving.
 - 2. Rotomilling greater than 1.5 inches in depth.
 - 3. Lane leveling is not considered an opportunity to improve ride.
- D. Pavement Section
 - 1. Each travel lane or median, 0.1 mile long. Sections include:
 - a. All traffic lanes
 - b. Ramps
 - c. Medians 8 ft and wider
 - d. Turn lanes
 - e. Approach slabs with final riding surfaces placed as part of the contract
 - 2. Each pavement section is laid out consecutively from the start of the project.
 - 3. Localized Roughness Criteria also applies to bike lanes and shoulders.
- E. Structure Section
 - 1. Each travel lane or median, 0.1 mile long. Sections include:
 - a. Bridges, approach slabs, and pavement within 25 ft of the approach slab with final riding surfaces placed as part of the contract.
- F. Wheel Path
 - 1. A continuous parallel line 2.5 ft inside the lane or median lines.
- G. Mean Roughness Index (MRI)
 - 1. Average of two wheel path IRIs taken from each pavement section.

- H. Localized Roughness
 - 1. Profile deviations in a continuous 25 ft pavement as identified using the ProVAL “Smoothness Assurance” analysis, calculating IRI with a continuous short interval of 25 ft [7.62 m] and the 250-mm filter applied.

1.5 SUBMITTALS

- A. Certifications for profilers and operators, for information.
- B. Summary report of acceptance profile testing for the project, including electronic file, for information. Refer to AASHTO R 43.
- C. Original raw data files compatible with the ASTM E 2560 standard. Refer to AASHTO R 43.
 - 1. Data files collected prior to beginning work for Category 2 pavements.
 - 2. Data files collected before corrective work.
 - 3. Data files collected for final acceptance.

1.6 GENERAL REQUIREMENTS

- A. Certify operators and equipment according to UDOT Materials Manual of Instruction 995.
 - 1. Use the prescribed filter settings from the certification for all measurements in this Section.
- B. Perform work necessary to prepare the pavement for testing, including sweeping.
- C. The Department may perform Independent Assurance testing according to AASHTO R 54 Verification Testing; coordinate this testing with the Engineer.

1.7 ACCEPTANCE

- A. The Department evaluates longitudinal deviations for all roadways using acceptance profiles performed by the Contractor.
 - 1. Determine IRI using the most recent version of Profile Viewer and Analysis (ProVAL) software. Refer to AASHTO R 54 and ASTM E 2560. Identify areas of localized roughness using the ProVAL “Smoothness Assurance” analysis, calculating IRI with a continuous short interval of 25 ft [7.62 m] and the 250-mm filter applied.
 - 2. Determine MRI for each Pavement Section and Structure Section with 250-mm filter applied.

- B. Limit transverse pavement deviations to less than $\frac{3}{16}$ inch from the lower edge of a 10-foot straightedge.
- C. Pavement smoothness is evaluated before and after corrective work. Final pavement smoothness acceptance is based on the profile of the final surface of all Pavement Sections of the project.
- D. Structure smoothness is evaluated before and after corrective work. Final structure smoothness acceptance is based on the profile of the final surface of all Structure Sections of the structure.
- E. Limit localized roughness as specified in Section 02742S.
 - 1. Include profile deviations from bridge decks, approach slabs and transitions, manholes, valves, and other facilities in the profile when the contract requires the adjustment, new construction or reconstruction of these facilities.
 - 2. Exclude profile deviations from bridge decks, approach slabs and transitions, manholes, valves, and other facilities in the profile when the contract does not include adjustment, new construction or reconstruction of these facilities.
 - 3. Limit profile deviations in shoulder or bike lane as specified in Section 02742S.

1.8 INCENTIVE/DISINCENTIVE

- A. The Department applies Incentive/Disincentive for final smoothness to Category 1 pavement surfaces longer than 1,000 ft and structure sections. Refer to Section 02742S.
 - 1. Prorate incentives/disincentives for partial pavement sections.
 - 2. Not eligible for incentives:
 - a. Pavement Sections requiring corrective action at the time of acceptance testing.
 - 1) Disincentives are based on the MRI obtained at the time of acceptance testing.
 - b. HMA and SMA Pavement Section where grinding exceeds 30 yd²; disincentive remains applicable.
 - 1) The minimum disincentive for these pavement sections is \$1,000 each.
 - c. Pavement Sections with grinding on the final surface of OGSC, and BWC.
- B. The Department applies Incentive/Disincentive for Category 2 pavements according to Section 02742S.
 - 1. The Department calculates the percent of improvement using the following formula:

$$\frac{[MRI_o - MRI_f] \times 100}{MRI_o}$$

Where:

MRI_o = MRI of original roadway surface

MRI_f = MRI of final corrected roadway surface

- C. The Department does not apply Incentives/Disincentives to:
1. Pavements shorter than 1,000 ft
 2. Shoulders
 3. Bike Lanes
 4. Medians narrower than 8 ft
 5. Horizontal curves with a centerline curvature radius less than 900 ft and areas within the superelevation transitions to these short radius curves
 6. Tapers
 7. Surfaces within 15 ft of bridge decks and approach slabs not constructed as part of the contract

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 MRI OF ORIGINAL ROADWAY SURFACE

- A. Profile existing roadway surface before beginning construction to determine MRI_o for Category 2 pavements.

3.2 PAVEMENT PROFILE CORRECTION

- A. Perform preliminary profiling and roadway smoothness evaluation to identify any defects exceeding acceptance limits.
- B. Correct defects before performing acceptance testing.
1. Measure and correct localized roughness defects in the underlying surface before placement of a final surface of OGSC, BWC, or SMA.
 2. Correct localized roughness defects across lanes, medians, and shoulders in widths terminating at a lane line, edge of pavement, or center of the lane either by grinding with a device approved by the Engineer or by surface replacement as approved by the Engineer. Refer to Section 02981.
 - a. Include areas not eligible for incentive/disincentive. Refer to this Section, Article 1.8, paragraph C.

3. Taper corrected areas for smooth transverse transitions and surface drainage.
4. Re-profile for correction verification before acceptance testing.
5. Seal corrected areas in BWC, OGSC, HMA, and SMA with a flush coat application.
 - a. Apply the emulsion according to Section 02748 for tack coat.

3.3 ACCEPTANCE TESTING

- A. Notify the Engineer at least two working days before performing acceptance testing for pavement smoothness.
 1. Clearly define each of the pavement sections to be evaluated.
- B. Perform acceptance testing for smoothness after all corrective work has been performed.
 1. Collect longitudinal profiles in each wheel path and in the center of each paved shoulder and bike lane using Department certified profilers and operators in accordance with AASHTO R 54, R 57 and M 328.
 - a. Collect profiles with no filters applied.
 2. Determine the MRI for each Pavement Section.
 3. Determine the MRI for each Structure Section.
 4. Determine localized roughness using IRI.
 5. Submit a summary report within two working days that includes pavement section identification, structure section identification, profile results, and bump locations showing localized roughness corrections by section.

3.4 PAVEMENT THICKNESS

- A. Determine PCCP thickness after smoothness acceptance testing.
- B. Re-test other pavements for thickness after grinding as determined by the Engineer.

END OF SECTION

SECTION 02705

CONCRETE AND ASPHALT CUTTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Saw or cut existing pavements, curb and gutter, sidewalk, and any appurtenances as required to provide a smooth surface to match.
- B. Does not apply to new Portland cement concrete pavement (PCCP) joint sawing. Refer to Section 02752.

1.2 RELATED SECTIONS

- A. Section 02748: Prime Coat/Tack Coat
- B. Section 02752: Portland Cement Concrete Pavement

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS **Not Used**

PART 3 EXECUTION

3.1 PROCEDURE – CONCRETE SURFACES

- A. Saw cut vertically in a straight line through the full depth of the surface.
- B. Make cuts so the defective surface can be removed where the edge of the existing surface is cracked, broken, or deteriorated.
 - 1. Verify that the entire deficient areas are removed and will not propagate.
- C. Do not allow traffic or construction equipment to cross the cut edge.

3.2 PROCEDURE – ASPHALT SURFACES

- A. Use any method that provides a vertical cut in a straight line through the full depth of the surface.
 - 1. Saw cut if the method of cutting does not produce a smooth, non-broken vertical edge.
- B. Make cuts so the defective surface can be removed where the edge of the existing surface is cracked, broken, or deteriorated.
 - 1. Verify that the entire deficient areas are removed and will not propagate.
- C. Do not allow traffic or construction equipment to cross the cut edge.
- D. Apply a tack coat to the cut edge before placing hot mix asphalt pavement when appropriate. Refer to Section 02748.

END OF SECTION

SECTION 02721

UNTREATED BASE COURSE (UTBC)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Production, construction, and compaction of UTBC used for pavements, shoulders, and incidental construction.

1.2 RELATED SECTIONS

- A. Section 01572: Dust Control and Watering

1.3 REFERENCES

- A. AASHTO T 11: Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- B. AASHTO T 19: Bulk Density ("Unit Weight") and Voids in Aggregate
- C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- D. AASHTO T 89: Determining the Liquid Limit of Soils
- E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- F. AASHTO T 96: Resistance to Degradation of Small-Sized Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- G. AASHTO T 180: Moisture-Density Relations of Soils Using a 4.54 kg (10 lb) Rammer and 457 mm (18 in) Drop
- H. AASHTO T 193: The California Bearing Ratio
- I. AASHTO T 255: Total Evaporable Moisture Content of Aggregate by Drying
- J. AASHTO T 335: Determining the Percent of Fracture in Coarse Aggregate
- K. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Written report for approval for each aggregate class and source, a minimum of five working days before placement. Include the following:
 - 1. Aggregate suitability. Refer to this Section, Part 2.
 - 2. Name of supplier and location of source.
 - 3. Maximum Dry Density and Optimum Moisture Content and associated test result data. Refer to AASHTO T 180, Method D.
 - 4. Job mix gradation including single values for each sieve size, No. 4 and finer. The target values must be within the gradation limits of Table 2.
- B. Job-mix gradation changes
 - 1. Refer to this Section, Article 3.1.

1.6 ACCEPTANCE

- A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. Type I Placement – Pavement Section
 - 1. Use Class A aggregate, Table 1.
 - 2. The Engineer takes random samples from the grade and tests for moisture, gradation, and laboratory density and performs in-place density determinations.
 - 3. Meet gradation limits and applicable tolerances of Table 2 for each gradation test. Evaluate each subplot separately and do not average with other sublots.
 - 4. Meet minimum density test average of 97 percent of maximum laboratory density with no test less than 94 percent.
- C. Type II Placement – Incidental includes placement for Curb, Curb and Gutter, Driveways, Pedestrian Access Ramps, Sidewalk, Waterways, Flatwork, and other items of work in the contract to which UTBC is included and not measured or paid for separately.
 - 1. Use Class A aggregate, Table 1.
 - 2. The Engineer takes random samples from the grade and tests for moisture, gradation, and laboratory density and performs in-place density determinations.
 - 3. Meet gradation limits and applicable tolerances of Table 2 for each gradation test. Each subplot will be evaluated separately and not averaged with other sublots.

4. Meet minimum density test average of 95 percent of maximum laboratory density with no test less than 92 percent.
- D. Type III Placement – Shoulder
 1. Use Class A or B aggregate, Table 1.
 2. Adjust moisture content before compaction.
 - E. Material not meeting the gradation requirements may be allowed to remain in-place at the discretion of the Engineer provided density requirements are met. Additional lots may not be placed until the deficiencies are addressed and corrected.
 - F. Correct material that does not meet the specified criteria by scarifying, placing additional material, re-mixing, reshaping, and re-compacting when determined by the Engineer.
 - G. Do not place additional material on any unaccepted layer.

PART 2 PRODUCTS

2.1 AGGREGATES

- A. Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, crushed gravel, or crushed slag, free of organic matter and contamination from chemical or petroleum products, according to Table 1.

Table 1

Aggregate Properties			
	Aggregate Class		
	A	B	
Dry Rodded Unit Weight	Not less than 75 lb/ft ³		AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	PI ≤ 6	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent		AASHTO T 96
Gradation	Table 2		AASHTO T 11 AASHTO T 27
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	N/A	AASHTO T 193
Two Fractured Faces	50% Min	N/A	AASHTO T 335

- B. Establish the job mix (target) gradation for the $\frac{3}{4}$ inch sieve and finer within the gradation limits.
1. The Job Mix Gradation Tolerance is the allowable deviation from the job mix (target) gradation on the applicable sieves.
 2. All other percents passing will be within the gradation limits. Refer to AASHTO T 11 and AASHTO T 27.

Table 2

Gradation Limits		
Sieve Size	Job Mix Gradation Target Band	Job Mix Gradation Tolerance
1½ inch	100	
1 inch	90 - 100	±9.0
$\frac{3}{4}$ inch	70 - 85	±9.0
$\frac{1}{2}$ inch	65 - 80	±9.0
$\frac{3}{8}$ inch	55 - 75	±9.0
No. 4	40 - 65	±7.0
No. 16	25 - 40	±5.0
No. 200	7 - 11	±3.0

Percent passing based on total aggregate (dry weight) and fine and coarse aggregate with approximately the same bulk specific gravities.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mixing – Provide moisture content of ± 2 percent of optimum at the time of placement. Refer to AASHTO T 180, Method D and AASHTO T 255.
- B. Procedures for Changing the Job-Mix Gradation
1. Submit changes in writing 24 hours before placement for approval by the Engineer.
- C. Placing – Place in layers of uniform thickness and compact each layer to a thickness not to exceed a 6 inch depth. Do not place on any frozen surface. Refer to Section 01572.
- D. Finishing – Uniform line and grade with surface deviations no more than $\frac{3}{8}$ inch in 10 ft in any direction.
1. Profile Tolerance – Correct any profile deviations greater than $\frac{3}{8}$ inch.
 - a. Rework minimum of 4 inch lift to achieve homogeneous density.
 - b. Determine limits of correction based on extent of deviation.
 - c. Continue finishing until existing deviation is less than $\frac{3}{8}$ inch.

- E. Compaction – Maintain optimum moisture content $\pm$ 2 percent.
 - 1. Use appropriate compaction equipment adjacent to abutments, backwalls, approach slabs, wing walls, retaining walls, and other structures.
 - 2. Use a minimum of two passes with a roller for Type III placement or as directed by the Engineer.

END OF SECTION

SECTION 02735

MICRO-SURFACING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and procedures for mixing and spreading a properly proportioned homogeneous mixture of aggregate, mineral filler, additives, polymer-modified asphalt emulsion and water to an existing pavement providing a firm surface adhesion and smooth stable skid resistant texture.

1.2 RELATED SECTIONS

- A. Section 02746: Hydrated Lime

1.3 REFERENCES

- A. AASHTO M 17: Mineral Filler for Bituminous Paving Mixtures
- B. AASHTO M 85: Portland Cement
- C. AASHTO M 208: Cationic Emulsified Asphalt
- D. AASHTO T 11: Materials Finer Than 75 μm (No. 200) Sieve in Mineral Aggregate
- E. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- F. AASHTO T 49: Penetration of Bituminous Materials
- G. AASHTO T 53: Softening Point of Bitumen
- H. AASHTO T 59: Testing Emulsified Asphalts
- I. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- J. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- K. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate

- L. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- M. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- N. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
- O. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
- P. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer
- Q. AASHTO PP 72-11: Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Techniques
- R. ASTM D 6372: Testing and Construction of Micro-Surfacing
- S. ASTM D 7405: Multiple Stress Creep and Recovery (MSCR) of Asphalt Binder Using a Dynamic Shear Rheometer
- T. International Slurry Seal Association (ISSA) Specifications and Guidelines
- U. UDOT Minimum Sampling and Testing Requirements
- V. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Provide the mix design for review 10 days before beginning construction.
 - 1. Refer to this Section, Article 2.6.
 - 2. Provide the Engineer with the following for asphalt and polymer emulsion with job-mix design.
 - a. Test report that meets the requirements of this Section, Article 2.1.
 - b. Certificate of analysis and compliance from the manufacturer for each batch.
 - c. Target gradation for combined aggregate and mineral filler.
 - d. Name of the asphalt and polymer emulsion supplier.

- B. Provide test reports for mineral aggregate.
 - 1. Refer to this Section, Article 2.2.
- C. Provide Manufacturer's Certificate of Compliance for Mineral Filler.
 - 1. Refer to this Section, Article 2.3.
- D. Provide calibration documentation for each mixing unit including an individual calibration for each material at various settings that corresponds to the mixing unit metering device.
- E. Changes in the job-mix gradation.
 - 1. Submit a written request for a change in the job-mix gradation.
 - 2. Submit a new job-mix design if changes in gradation are outside the gradation band allowed by the stockpile tolerance in Table 4.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material according to UDOT Minimum Sampling and Testing Requirements.
- B. Department will assess price adjustments based on the average daily application rate of aggregate and emulsion residue per lot.
 - 1. A lot is defined as one day's production.
 - 2. Use the computerized monitoring system from the paver for the aggregate and emulsion totals per lot.
 - 3. Obtain square yards from the Contractors Daily Report, verified by the Engineer.
 - 4. Pay Factor = PF_{rate} (Table 1) x PF_{residue} (Table 2)
- C. Application rate pay factor (PF_{rate}) is based on application rate of dry aggregate.
 - 1. Aggregate application target rate is 25 lbs/yd²

Table 1

Pay Factor Application Rate	
Average Daily Application Rate (lbs/yd ²)	PF_{rate}
25.0 or Greater	1.0
20.0 to 24.9	(Avg. Rate ÷ 25)
Less than 20.0	Reapplication with option to remove

- D. Emulsion residue pay factor (PF_{residue}) is based on the residue of the emulsion placed each lot.
1. Target Value = Residual asphalt target value for emulsion based on the mix design.
 2. Emulsion residue = Based on the Certificate of Compliance from the Emulsion Supplier.

Table 2

Pay Factor Emulsion Residue Content	
Average Daily Emulsion Residue %	PF_{residue}
Target Value less than $\pm 0.6\%$	1.0
Target Value $\pm 0.61\%$ to Target Value $\pm 1.00\%$	0.8
Greater than 1% of Target Value	Reapplication with option to remove

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

- A. Use a quick-set polymer-modified asphalt emulsion manufactured specifically for micro-surfacing.
1. Refer to AASHTO M 208 grade CQS-1 h (cationic) emulsified asphalt. Delete settlement and cement mixing test requirements.
 2. The supplier must be on the approved list adhering to the UDOT Quality Management Plan 508 Asphalt Emulsion.
- B. Mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process.
1. Obtain certification from the asphalt emulsion manufacturer that the emulsion contains at least 3.0 percent polymer solids based on the weight of asphalt (asphalt residual).
- C. Refer to Table 3 for Modified Emulsion Residue.

Table 3

Modified Emulsion Residue By Distillation		
Test Method	Description	Specification
AASHTO T 49	Penetration, 25° C	40-90
AASHTO T 53	Softening point	57° C Min
AASHTO T 59-modified (a)	Residue by distillation	62% Min.
AASHTO T 316	Rotational Viscosity 135° C	650 CPS Min
Modified Emulsion Residue By Evaporation, AASHTO PP 72-11 Procedure B		
AASHTO T 315 (b)	Original DSR, G* at 58° C, kPa	7 - 14
AASHTO T 315 (b)	Original DSR, Phase Angle, δ , at 58° C	75 Max.
ASTM D 7405 (b)	Multiple Stress Creep Recovery (MSCR) at 64° C, % recovery at 3.2 kPa stress level	25 Min.
(a)	Modified distillation procedure – Heat emulsion residue to $177 \pm 5^\circ \text{C}$ and maintain that temperature for 20 min. Perform the distillation within 60 ± 15 min.	
(b)	Do not reheat on completion of evaporation. Complete residue testing within 48 hr of performing the evaporation procedure. Pull small specimens from the evaporation sample for rheological testing and ball by hand using gloves that will not affect the residue such as nitrile gloves.	

- D. Formulate the polymer modified emulsified asphalt so that when the paving mixture is applied with relative humidity at not more than 50 percent and the ambient air temperature of at least 75 degrees F, the paving mixture will sufficiently cure so that traffic can be allowed in one hour.

2.2 MINERAL AGGREGATE

- A. Use 100 percent crushed mineral aggregates, clean and free from organic matter or other detrimental substances that meet the following requirements:
1. Maximum clay lumps and friable particles of 2 percent for coarse and fine aggregates. Refer to AASHTO T 112.
 2. Maximum weighted sodium sulfate soundness loss of 15 percent. Refer to AASHTO T 104.
 3. Maximum loss by abrasion of 30 percent. Refer to AASHTO T 96.
 4. Sand equivalent of 60 or greater. Refer to AASHTO T 176.
 5. Minimum polishing value of 31. Refer to AASHTO T 278 and T 279.
 - a. Perform tests on aggregate before crushing.
 - b. Do not use predominantly limestone or dolomite aggregates.

- B. Establish a job mix or target gradation within the gradation band as specified in Table 4.
 1. Base the mix design on the target gradation.
 2. The percent passing each sieve must not vary by more than the stockpile tolerance and still remains within the gradation band. Refer to AASHTO T 11 and AASHTO T 27.

Table 4

Job-Mix Gradation Design Limits		
Sieve Size	Job Mix Gradation Target Band	Stockpile Tolerances
$\frac{3}{8}$	100	0
#4	70-90	±5
#8	45-70	±5
#16	28-50	±5
#30	19-34	±5
#50	12-25	±4
#100	7-18	±3
#200	5-15	±2

Percent passing based on total aggregate (dry weight) and fine and coarse aggregate with approximately the same bulk specific gravities.

2.3 MINERAL FILLER

- A. Use one of the following for Mineral Filler. Refer to AASHTO M 17.
 1. Non-air entrained Type I/II portland cement. Refer to AASHTO M 85.
 2. Hydrated lime, free from lumps or foreign matter. Refer to Section 02746.
- B. Determine the amount of mineral filler needed through the laboratory mix design.
 1. The amount of mineral filler used must be between 0.5 percent and 2.0 percent by the weight of dry aggregate.
 2. Adjust the percentage of mineral filler ± 0.5 percent as necessary for better consistency or to optimize set times with Engineer's approval.

2.4 WATER

- A. Use potable water free from harmful salts, reactive chemicals, and any other contaminants.

2.5 ADDITIVES

- A. Use additives as required to accelerate or retard the break-set of the micro-surfacing mix, to improve the resulting finished surface, or to increase adhesion.
 - 1. Determine the initial additive quantities from the mix design for the micro-surfacing mix or individual materials.
 - 2. Use additives compatible with the other components of the mix.

2.6 JOB-MIX DESIGN

- A. Design according to ASTM D 6372.
 - 1. Show each ingredient amount meets the following:
 - a. Residual asphalt cement content, 7.0 percent minimum by dry total weight of aggregate.
 - b. Aggregate gradation (target) within the job-mix gradation design limits in Table 4.
 - c. Mineral filler, percentage by total dry weight of aggregate.
 - d. Polymer modifier 3.0 percent minimum polymer solids based on the residual asphalt content certified by emulsion supplier.
 - 2. Identify the optimum emulsion content as a percentage of the dry weight of aggregate to meet Table 5 requirements.
 - 3. Identify additives as determined by design testing to control mix set times and cohesion.
 - a. Provide acceptable limits for additives.
 - 4. Conform to the ISSA A143 specifications listed in Table 5.
 - 5. Use the same materials and aggregate gradation to be used on the project.
 - 6. Provide a micro-surfacing mixture that can be spread in variable thickness cross-sections, ruts, scratch courses, and surfaces.

Table 5

ISSA A 143 Specifications		
ISSA Test No.	Description	Specification
ISSA TB-139	<u>Wet Cohesion</u> @ 30 Minutes Minimum (Set) @ 60 Minutes Minimum (Traffic)	12 kg-cm Minimum 20 kg-cm Minimum or Near Spin
ISSA TB-109	Excess Asphalt by LWT Sand Abrasion	50 g/ft ² Maximum (538 g/m ² Maximum)
ISSA TB-114	Wet Stripping	Pass (90% Minimum)
*ISSA TB-100	<u>Wet-Track Abrasion Loss</u> One-hour Soak Six-day Soak	50 g/ft ² (538 g/m ²) Maximum 75 g/ft ² (807 g/m ²) Maximum
ISSA TB-147	Lateral Displacement	5% Maximum
ISSA TB-144	Classification Compatibility	11 Grade Points Minimum (AAA, BAA)
ISSA TB-113	Mix Time @ 77° F (25° C)	Controllable to 120 Seconds Minimum

* Perform the wet track abrasion test under laboratory conditions as a component of the mix design process.

2.7 EQUIPMENT

- A. Use mixing equipment specifically designed and manufactured to mix and place micro-surfacing.
 1. Mix the material by an automatically sequenced, self-propelled micro-surfacing mixing machine with a continuous flow revolving multi-blade double shafted mixing unit that:
 - a. Accurately delivers and proportions the aggregate, emulsified asphalt, mineral filler, controls setting additive, and water.
 - b. Discharges the mixed product on a continuous flow basis.
 2. Use a machine with sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls.
 3. Use a machine capable of self-loading materials while continuing to place micro-surfacing.
 4. Full control of the forward and reverse speed during applications of the micro-surfacing material.
 - a. Use original manufacturer designed equipment for the self-loading device, opposite side driver stations, and forward and reverse speed controls.
- B. Use a machine with a hydraulically adjustable (while applying mixture) type spreader box with a positive screed adjustment for yield control and a positive adjustment for the joint matcher.

- C. Equip the micro-surfacing spreader box with the following:
 - 1. Ribbon flights mounted on an adjustable shaft to continually agitate and distribute the materials throughout the box.
 - 2. Curb bumpers and replaceable runners with at least 5 ft long end runners.
 - 3. A sufficient walkway to provide access to either side of the spreader box without walking through the freshly placed material.
 - a. The equipment must provide sufficient turbulence to prevent the mix from setting in the box or causing excessive side buildup or lumps.
 - 4. Flexible seals in contact with the road, front and rear, to prevent the loss of the mixture from the box.
 - 5. A secondary strike-off located approximately 2 to 3 ft behind the primary strike-off to minimize transverse corrugations and to improve surface texture.
 - a. The secondary strike-off must have elevation and width adjustments similar to the primary strike-off and a pivot point that can be tilted for texturing or raised completely off the surface.
 - b. The secondary strike-off must have the same adjustments as the spreader box.
 - 6. Ability to side shift the box to compensate for variations in the pavement geometry.
 - 7. Capability of applying micro-surfacing mixture in variable widths up to 15 ft.
- D. Use a rut filling spreader box specifically designed to fill ruts with an average depth greater than $\frac{1}{2}$ inch.
 - 1. Ruts greater than $\frac{1}{2}$ inch deep require multiple passes to restore the cross section.
- E. Use a computerized material monitoring system with integrated material control devices such that the amount of each material can be determined at any time.
 - 1. Calibrate each material control device before each mix application and as often thereafter as determined by the Engineer.
 - 2. Use a monitoring system capable of recording, displaying, and printing the following information:
 - a. Individual sensor counts for emulsion, aggregate, mineral filler, water, and additive.
 - b. Aggregate, emulsion, and mineral filler output in pounds per minute.
 - c. Percentages of emulsion, mineral filler, water, and additive.
 - d. Cumulative totals of aggregate, emulsion, mineral filler, water, and additive.
 - e. Scale factor for all materials.

- F. Check the daily totals from the computerized monitoring system for the aggregate and the daily total from the scalping screen weighing system are within 2 percent.
- G. Calibrate each mixing unit in the presence of the Engineer before construction.
 - 1. Do not use any machine until calibration has been completed.

PART 3 EXECUTION

3.1 LIMITATIONS

- A. Do not apply micro-surfacing during rain when road surface moisture is present or during other adverse weather conditions.
- B. Do not apply micro-surfacing if either the pavement or air temperature is below 50 degrees F.
- C. Do not apply micro-surfacing when the temperature is projected below 37 degrees F within 48 hours of placing micro-surfacing.
- D. Cease micro-surfacing operations when the weather or other conditions prolong opening road surface to traffic beyond two hours.
- E. Remove and replace the micro-surfacing if any of the following occurs:
 - 1. Lumping, balling, or unmixed aggregates.
 - 2. Separation of the coarse aggregate from the emulsion and fines.
 - 3. Excessive breaking of emulsion inside the spreader box.
 - 4. Streaking caused by oversized aggregate.
 - 5. Flushing or excessively rich areas appearing in the micro-surfacing after two hours from the time of placement.
 - 6. Any measurable rutting, shoving, or other evidence of premature deformation when exposed to traffic.
- F. Keep traffic off roadway surface until the micro-surfacing has cured.
 - 1. Allow for additional curing time at locations such as driveways, intersections, and where sharp turning movements may take place or where vehicles may accelerate quickly.

3.2 STOCKPILE

- A. Construct individual 500-ton stockpiles of micro-surfacing aggregates.
 - 1. Engineer will verify stockpiles at least one and at most seven days before use.

2. Combining, altering, or moving 500-ton stockpiles may require re-approval by the Engineer before use.
- B. Notify the Engineer at least seven calendar days before micro-surfacing placement in order for the initial stockpiles to be sampled and tested for acceptance.
- C. Obtain the Engineer's written acceptance of a stockpile before its use for micro-surfacing.
- D. Provide stockpile Quality Control information to the Engineer for every 500 tons of aggregates to include the following:
 1. Aggregate gradation meeting job-mix formula tolerances according to Table 4.
 2. Sand Equivalency. Refer to AASHTO T 176.
- E. Be capable of determining aggregate moisture within 10 minutes at all times.
- F. Rework or remove material not meeting specifications from the stockpile area. Identify stockpiles that will be reworked.
- G. The Department will retest corrected material for acceptance.

3.3 PREPARATION

- A. Clean the pavement surface of dirt, sand, dust, oil, and other objectionable material immediately before applying micro-surfacing.
- B. Allow un-sealed cracks to dry thoroughly before applying micro-surfacing when using water to clean the road surface.
- C. Cover manholes, valve boxes, drop inlets, and other service utility entrances before surfacing.
- D. Protect all structures, including items such as guardrail, guideposts, concrete barriers, drains, and parapet walls.

3.4 APPLICATION

- A. Pre-wet the pavement surface as required due to local conditions by fogging ahead of the micro-surfacing box.
 1. Do not create standing water on the pavement in front of the micro-surfacing box.

- B. Place micro-surfacing mix that meets the job-mix design.
 - 1. Control the ingredient proportions with metering or measuring devices on the micro-surfacing equipment.
 - a. Use readings from the metering or measuring devices to determine compliance with limits stated in the approved job-mix design.
 - 2. Limit any increase or decrease in the amount of mineral filler added to the mix during production to ± 1 percent of the job-mix design.
 - 3. Limit the set-control agent to ± 1 percent of the job-mix design.
 - 4. The emulsion used throughout the project must be the same emulsion submitted with the job-mix design.
 - 5. The emulsion content must be ± 1 percent of the job-mix design.
 - a. Engineer may require a new job-mix design and re-authorization of the micro-surfacing if large disparities occur.
 - b. Calculate the percent emulsion on the daily electronic printout from the calibrated paver for emulsion and aggregate quantities.
- C. Place a mixture according to the authorized mix design and the quality control tolerances.
 - 1. Maintain quality control documentation and make available to the Engineer upon request or at completion of daily work.
 - 2. Randomly calculate the percent asphalt content of the mixture from the equipment computer display readings at least three times daily.
 - 3. Randomly calculate the yield of the aggregate being placed from the equipment computer display readings at least three times daily.
 - 4. Maintain a daily report and log sheet containing the following information:
 - a. Aggregate used, ton (dry)
 - b. Micro-Surfacing emulsion used, ton
 - c. Bituminous materials for tack coat used, if specified, ton
 - d. Mineral Filler used, lbs
 - e. Water used in mixture, gallons
 - f. Additive used in mixture, gallons
 - g. Surface area completed (square yards)
 - h. Surface area application rate (dry lbs aggregate per square yard)
 - i. Percentage of emulsified asphalt based on dry aggregate
- D. Pass the mineral aggregate over a vibratory scalping screen before transfer to the micro-surfacing mixing machine to remove oversize material.
 - 1. The screening unit must be capable of providing weigh tickets for each load of material.

- E. Carry a sufficient amount of micro-surfacing in all parts of the spreader box so that full width and complete coverage is obtained with no streaks or narrow spots.
 - 1. Avoid overloading the spreader box.
 - 2. Do not spray water directly into the spreader box during the application of micro-surfacing under any circumstances.
- F. Apply micro-surfacing of proper consistency at a minimum rate of 25 lbs/yd² based on the dry weight of aggregate for each lot.
 - 1. Provide to the Engineer the square yards for each lot.
 - 2. Calculate the aggregate application rate using the daily tickets from the screening unit and daily electronic printout from the calibrated paver.
- G. Apply micro-surfacing for rut filling.
 - 1. Apply micro-surfacing as a scratch-coat pass using a steel or high density strike-off when required to fill ruts less than ½ inch deep or as directed by the Engineer.
 - 2. Make multiple passes with the rut filling spreader box for ruts greater than ½ inch deep or as directed by the Engineer.
 - 3. Allow 24-hour cure time after filling ruts, before placing additional micro-surfacing layer.
- H. Do not apply water to freshly placed micro-surfacing.

3.5 TEST STRIP

- A. Construct a test strip at least 500 ft long on the roadway before initial placement.
 - 1. The material must achieve initial set within 30 minutes and the surface shows no signs of distress when exposed to traffic after curing for 2 hours.
- B. Make necessary adjustments if test strip does not perform as required.
 - 1. Repeat the test strip process.
 - 2. The Engineer may require a new job-mix design if failures indicate an ingredient problem.

3.6 FINISHING DETAILS

- A. The depth of each micro-surfacing course must not exceed twice the maximum aggregate size.
 - 1. Not required when using a rut filling spreader box.

- B. Longitudinal and transverse joints
 1. Construct longitudinal joints within 6 inches of the lane lines where possible.
 2. The overlap of micro-surfacing at any joint must not exceed 6 inches.
 3. Repair the joints if any of the following conditions exist:
 - a. Build-up of material at the joints.
 - b. Uncovered areas at the joints.
 - c. Longitudinal and transverse joints with more than $\frac{1}{4}$ inch vertical space between the surface and a 4 ft straightedge placed perpendicular to the joint.
 4. The edges of the micro-surfacing must follow the centerline, lane lines, shoulder lines, and curb lines.
 5. Repair the edges if they vary more than 6 inches.
 6. Use methods approved by the Engineer to correct deficiencies.
 - a. The repaired surfaces must be dense with a uniform texture.
 - b. Repair sections with surface irregularities the same width as the existing pass of micro-surfacing.
 - c. Small areas of patching are not permitted.
- C. Finished micro-surfacing must have a uniform texture free of scratches, tears, and other surface irregularities.
 1. Repair the surface if any of the following deficiencies exist:
 - a. More than one surface irregularity $\frac{1}{4}$ inch or wider and 10 ft or longer in any 100 ft section.
 - b. More than three surface irregularities $\frac{1}{2}$ inch or wider and more than 6 inches long in any 100 ft section.
 - c. Any surface irregularity 1 inch or wider and more than 4 inches long.
 - d. Any tire track damage to the fresh micro-surfacing.
 - e. Slick spots or any area of bleeding (surface flushing).
- D. Place micro-surfacing adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge.
 1. Do not allow over-lap in these areas.
- E. Maintain neat construction lines at all locations.
- F. Place micro-surfacing at side streets and intersections out to right-of-way line including around radii where applicable.

- G. Use hand squeegees to spread micro-surfacing in areas where micro-surfacing machine cannot operate.
 - 1. Lightly dampen areas before mix placement.
 - 2. Provide complete and uniform coverage.
 - 3. Avoid unsightly appearance from handwork.
 - 4. Use the same type of finish in hand worked areas as applied by the spreader box.

- H. Use construction paper or comparable products so that beginning and ending joint lines from each construction pass are straight and neat.

END OF SECTION

SECTION 02741

HOT MIX ASPHALT (HMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. A surface course of one or more layers of HMA comprised of aggregate, asphalt binder, hydrated lime, and other additives.
- B. Option to incorporate Reclaimed Asphalt Pavement (RAP) materials into HMA pavement.

1.2 RELATED SECTIONS

- A. Section 01456: Materials Dispute Resolution
- B. Section 02701: Pavement Smoothness
- C. Section 02742S: Project Specific Surfacing Requirements
- D. Section 02745: Asphalt Material
- E. Section 02746: Hydrated Lime
- F. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

- A. AASHTO M 323: Superpave Volumetric Mix Design
- B. AASHTO R 35: Superpave Volumetric Design for Hot-Mix Asphalt (HMA)
- C. AASHTO T 19: Bulk Density ("Unit Weight") and Voids in Aggregate
- D. AASHTO T 89: Determining the Liquid Limit of Soils
- E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- F. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

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- H. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
- I. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- J. AASHTO T 195: Determining Degree of Particle Coating of Asphalt Mixtures
- K. AASHTO T 209: Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
- L. AASHTO T 255: Total Evaporable Moisture Content of Aggregate by Drying
- M. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- N. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- O. UDOT Materials Manual of Instruction
- P. UDOT Minimum Sampling and Testing Requirements
- Q. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Longitudinal Joint – Any new asphalt lift abutting an existing paving lift, exceeding 200 feet in length and excluding intersections. This includes joints created by echelon paving and new asphalt placed against a milled asphalt edge.
- B. Lot – The number of tons of HMA placed in a Production Day.
- C. Minor Target Change – A change from the verified mix design gradation target on a maximum of two sieves with the following limitations.
 - 1. The maximum change in the target gradation on the #8 or any coarser sieve is limited to 3 percent passing per sieve.
 - 2. The maximum change in the target gradation on the #16 or #50 sieves is 2 percent passing per sieve.
 - 3. The maximum change in the target gradation on the #200 sieve is 0.5 percent passing.
 - 4. No target change may violate the mix design requirements in this section.

- D. Overband – an 8 inch protective asphalt coating sealing the longitudinal joint of final riding surface, as proposed by the contractor and approved by the Engineer
- E. Production Day – A 24 hour period in which HMA is being placed.
- F. RAP – Recycled Asphalt Pavement. Crushed or milled asphalt materials that have been removed from pavements.
- G. Thin Overlay Pavement – An overlay where the sum of the thickness of the HMA lifts is less than two inches.

1.5 SUBMITTALS

- A. Mix design for approval at least 10 working days before paving according to the UDOT Materials Manual of Instruction 960.
- B. Changes in job mix design
 - 1. Submit a written request for any proposed change in the job-mix gradation.
 - a. Allow at least 12 hours for approval before incorporating a minor target change into production.
 - b. Allow at least six working days for verification and approval of any other change.
 - 2. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Department acceptance test results or Contractor QC test data or both are acceptable.
 - 3. Submit samples according to the UDOT Materials Manual of Instruction 960 for a volumetric mix design verification for anything other than approved minor target changes. This includes changes in the aggregate source, asphalt binder source, or asphalt binder grade.
- C. Corrective action plan for approval according to this Section, Article 3.3, paragraph B and Article 3.4, paragraph A4b.
- D. Mat joint layout plan to the Engineer for review at least 10 calendar days before placement.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

- B. Gradation and asphalt binder content
1. The Engineer evaluates a lot on the test results of four samples with the following exceptions:
 - a. Compute incentive/disincentive using the test results from three samples if only three samples can be taken for the production day.
 - b. Combine test results with the next day of production if at least three random samples cannot be taken. Take one sample for each 500 tons, or portion thereof, from the following day's production.
 - c. Add the lot to the previous day's production for the final day's production if three random samples cannot be taken.
 - d. The lot may be increased to include up to three production days when agreed upon in advance by both the Contractor and the Engineer when less than 900 tons are anticipated per production day.
 2. Evaluate the lot using the number of tests "n" in Table 3.
 3. The Engineer informs the Contractor of the time and place of sampling not more than 15 minutes before sampling.
- C. Density and Thickness
1. Obtain cores from the mat and longitudinal joint within two contract days after the pavement is placed. Refer to UDOT Materials Manual of Instruction 984.
 - a. The Engineer marks coring location for in-place mat density and longitudinal joint density cores.
 - b. Move transversely to a point 1 ft from the edge of the pavement for in-place mat density if the random location for coring falls within 1 ft of the edge of the overall pavement section (outer part of shoulders).
 - c. Fill core holes with HMA or high AC content cold mix and compact.
 - d. The Department witnesses the coring operation, takes possession of the cores immediately, and begins testing the cores within 24 hours for density acceptance.
 2. Density Requirements
 - a. The target for in-place density for the mat is 93.5 percent of Theoretical Maximum Specific Gravity except for thin overlay pavements.
 - b. The target for in-place density for the longitudinal joint is 91.5 percent of the Theoretical Maximum Specific Gravity (Gmm).
 - 1) Use the average of both Gmm's if two different sides or values exist for the cores taken.

- c. The target for in-place density is 92.5 percent of Theoretical Maximum Specific Gravity for Thin overlay pavement projects.
 - 1) Do not take longitudinal joint cores for thin overlay pavement.
 - d. Use the average of the Theoretical Maximum Specific Gravity tests for each lot.
 - e. Acceptance for in-place mat and longitudinal joint density may be based on establishing a rolling pattern for items such as bridge decks, utility work, traffic signals, detours, lane leveling, driveways, other handwork, or small projects with plan quantities less than 500 tons.
3. Thickness Requirements are based only on mat cores. The thickness requirement may be waived when matching up to existing pavement, curb and gutter for Pavement in or next to intersections.
- a. The Department accepts a lot for thickness when:
 - 1) The average thickness is not more than $\frac{1}{2}$ inch greater or $\frac{1}{4}$ inch less than the total design thickness specified.
 - 2) No individual subplot shows a deficient thickness of more than $\frac{3}{8}$ inch.
 - b. Excess Thickness – The Engineer may allow excess thickness to remain in place or may order its removal.
 - 1) The Department pays for 50 percent of the mix for material in excess of the $+\frac{1}{2}$ inch tolerance when excess thickness is allowed to remain in place.
 - c. Deficient Thickness – Place additional material where lots or sublots are deficient in thickness.
 - 1) The Department pays for material necessary to reach specified thickness.
 - 2) The Department pays for 50 percent of the mix for additional material over specified thickness necessary to achieve minimum lift thickness.
 - 3) Minimum compacted lift is 3 times the nominal maximum aggregate size.
 - d. Thickness tolerances established above do not apply to leveling courses. Check final surfaces in stage construction.
 - e. Check thickness regularly with a depth probe and take corrective action as necessary for thin overlay pavement.
4. Longitudinal Joint
- a. The edge of a new asphalt mat may be removed for the purpose of meeting longitudinal joint density requirements.
 - 1) The material wasted is still included in the payment.
 - 2) Up to 3 inches for a confined edge is allowed.
 - 3) Up to 6 inches for an unconfined edge is allowed.

- D. The Department applies one Incentive/Disincentive for the lowest dollar value for Gradation/Asphalt Content, one Incentive/Disincentive for In-Place Mat Density, and one Incentive/Disincentive for Longitudinal Joint Density. The Engineer computes Incentives/Disincentives as follows for each lot. Refer to Section 02701 for smoothness requirements.
1. Compute incentive/disincentive for Gradation/Asphalt Binder and In-place Mat Density and Longitudinal Joint Density according to Table 1.
 2. Base the incentive/disincentive on Percent within Limit (PT) computation using Tables 2, 3, and 4.
 3. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content incentive/disincentive.
 4. Use Tables 2, 3, and 4 to determine PT for in-place Mat Density and Longitudinal Joint Density.
 5. Meet PT of 88 or greater for in-place mat density or the Department does not pay incentives on gradation/asphalt binder content.
 6. The Department pays/assesses the longitudinal joint density incentive/disincentive per ton of HMA placed adjacent to, and on the hot side of the longitudinal joint for each lift:
 - a. The incentive/disincentive will be calculated from the average of the core densities taken from all abutting joints if the HMA mat has a longitudinal joint on more than one side.
 7. The following work is not eligible for incentive:
 - a. Items such as utility work, traffic signals, detours, lane leveling, and driveways.
 - b. Small projects with plan quantities of HMA less than 500 tons.
- E. The Department rejects lots:
1. According to Table 1.
 2. The Engineer may accept a reject lot. Refer to Section 01456.
 - a. A price reduction of 35 percent of the pay item or \$20 per ton, whichever is greater, will be assessed.
 - b. The lot will not be eligible for any incentive.
- F. The Engineer may elect to accept material on visual inspection for work such as utility work, traffic signals, detours, lane leveling, and driveways, other hand work, or small projects with plan quantities less than 500 tons.
1. Lots accepted on visual inspection are not eligible for Incentive/Disincentive.
 2. The Engineer reserves the option of conducting any acceptance tests necessary to determine that the material and workmanship meets the project requirements.

3. Acceptance for mat density and longitudinal joint density may be based on establishing and maintaining a roller pattern to obtain maximum density without over-stressing the pavement.

Table 1

Incentive/Disincentive for Asphalt Binder Content, and Mat Density	
PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	2.00
96-99	1.50
92-95	1.00
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
<60	Reject
Incentive/Disincentive for Gradation	
PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	2.00
96-99	1.50
92-95	1.00
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
56-59	-5.00
52-55	-10.00
<52	Reject
Incentive/Disincentive for Longitudinal Joint Density	
PT Based on Min Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	2.00
96-99	1.50
92-95	1.00
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
56-59	-2.60
52-55	-5.00
<52	The \$5 penalty and Overband Longitudinal Joint if Final Surface Lift

Table 2

Upper and Lower Limit Determination	
Parameter	UL and LL
$\frac{3}{4}$ inch sieve for 1 inch HMA $\frac{1}{2}$ inch sieve for $\frac{3}{4}$ inch HMA $\frac{3}{8}$ inch sieve for $\frac{1}{2}$ inch HMA No. 4 sieve for $\frac{3}{8}$ inch HMA	Target Value $\pm$ 6.0%
No. 8 sieve	Target Value $\pm$ 5.0%
No. 50 sieve	Target Value $\pm$ 3.0%
No. 200 sieve	Target Value $\pm$ 2.0%
Asphalt Binder Content	Target Value $\pm$ 0.35%
Mat Density	Lower Limit Target Value - 2.0% Upper Limit Target Value + 4.0%
Longitudinal Joint Density	Lower Limit Target Value - 2.0% Upper Limit Target Value + 6.0%

Table 3

Enter table in the appropriate “number of tests” column and round down to the nearest value.

Quality Index Values (QU or QL) for Estimating Percent Within Limits										
PU or PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.23

Table 3 Continued										
PU/PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21	0.21	0.20
57	0.25	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.15
55	0.18	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.04	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

Table 4

Definitions, Abbreviations, and Formulas for Acceptance	
Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content are given in the Contractor's volumetric mix design. See this Section, article 1.6 for density target values.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results—the arithmetic mean.
Sample Standard Deviations	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 2)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 2)
Upper Quality Index (QU)	$QU = (UL - AVE)/s$
Lower Quality Index (QL)	$QL = (AVE - LL)/s$
Percentage of Lot Within UL (PU)	Determined by entering Table 3 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 3 with QL.
Total Percentage of Lot Within UL and LL (PT)	$PT = (PU + PL) - 100$
Incentive/Disincentive	Determined by entering Table 1 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to at least four decimal places and carried through all further calculations. Rounding to lower accuracy is not allowed.

1.7 DISPUTE RESOLUTION

- A. Refer to Section 01456 when disputing the validity of the Department's acceptance tests.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

- A. Project Specific Surfacing Requirements – Refer to Section 02742S.
- B. Asphalt Material – Refer to Section 02745.

2.2 AGGREGATE

- A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
- B. Refer to Table 5 to determine the suitability of the aggregate.
 - 1. Coarse aggregates
 - a. Retained on No. 4 sieve
 - 2. Fine aggregates
 - a. Clean, hard grained, and angular
 - b. Passing the No. 4 sieve

Table 5

Aggregate Properties – HMA			
Test Method	Test No.	75 Design Gyration and Greater	Less Than 75 Design Gyration
One Fractured Face	AASHTO T 335	95% minimum	85% min (1 inch and $\frac{3}{4}$ inch) 90% min ($\frac{1}{2}$ inch and $\frac{3}{8}$ inch)
Two Fractured Face	AASHTO T 335	90% minimum	80% min (1 inch and $\frac{3}{4}$ inch) 90% min ($\frac{1}{2}$ inch and $\frac{3}{8}$ inch)
Fine Aggregate Angularity	AASHTO T 304	45 minimum	45 minimum
Flakiness Index	UDOT MOI 933 (Based on $\frac{3}{8}$ inch sieve and above)	17% maximum	17% maximum
L.A. Wear	AASHTO T 96	35% maximum	40% maximum
Sand Equivalent	AASHTO T 176 (Pre-wet method)	60 minimum	45 minimum
Plasticity Index	AASHTO T 89 and T 90	0	0
Unit Weight	AASHTO T 19	minimum 75 lb/cu ft	minimum 75 lb/cu ft
Soundness (sodium sulfate)	AASHTO T 104	16% maximum loss with five cycles	16% maximum loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% maximum	2% maximum
Natural Fines	N/A	0%	10% maximum

C. Meet gradation requirements in Table 6.

Table 6

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)					
Sieve Size		1 inch	$\frac{3}{4}$ inch	$\frac{1}{2}$ inch	$\frac{3}{8}$ inch
Control Sieves	$1\frac{1}{2}$ inch	100.0			
	1 inch	90.0 - 100.0	100.0		
	$\frac{3}{4}$ inch	<90	90.0 - 100.0	100.0	
	$\frac{1}{2}$ inch		<90	90.0 – 100.0	100.0
	$\frac{3}{8}$ inch			<90	90.0 - 100.0
	No. 4				< 90
	No. 8	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0
	No. 200	1.0 - 7.0	2.0 - 8.0	2.0 – 10.0	2.0 – 10.0

2.3 HYDRATED LIME

- A. Meet the requirements of Section 02746.

2.4 RECLAIMED ASPHALT PAVEMENT (RAP) (OPTIONAL)

- A. Do not adjust the asphalt binder grade if the lower end is already a PG XX-34.
- B. Do not adjust the asphalt binder grade when RAP content is not more than 15 percent by total weight of the hot mix and RAP asphalt binder content is not more than 15 percent of the total asphalt binder content by weight.
- C. Adjust asphalt binder grade according to AASHTO M 323 when RAP asphalt binder content is between 15 to 25 percent of the asphalt binder weight.
 - 1. Select one grade softer than the grade specified. Do not adjust the asphalt binder grade if the lower end is already a PG XX-34.
 - 2. Provide test reports indicating that the PG grade and quantity of the recovered asphalt binder is consistent throughout the stockpile.
 - 3. Limit RAP to 25 percent of the total weight of the hot mix and RAP binder to 25 percent of the total binder.
- D. RAP aggregate is required to meet Table 5 with exception of Sand Equivalent. Refer to AASHTO T 176.

2.5 VOLUMETRIC MIX DESIGN

- A. Perform Superpave Volumetric Mix Design according to UDOT Materials Manual of Instruction 960 and the following:
 - 1. Incorporate hydrated lime into all designs. Refer to Section 02746.
 - 2. Comply with Table 7 and Table 8.
- B. Obtain Department approval for the mix design. Refer to the UDOT Materials Manual of Instruction 960.
 - 1. Do not begin paving until approved.
- C. Mix Design Changes
 - 1. The Department may allow up to two minor target changes per project without penalty to contractor. The Department charges \$1,000 for each additional minor target change.

2. The Department allows up to two volumetric mix design verifications, (including field verifications), per project. The Department charges \$3,000 for each additional laboratory or field verification required. This includes all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.
3. The Engineer will review each change and provide written notice of approval or rejection of each mix design change.

Table 7

Volumetric Design Gyration				
20 Years Design ESALS (Million)	Compaction Parameters			Voids Filled with Asphalt (VFA) (%)
	N_{initial} /% of G_{mm}[*]	N_{design} /% of G_{mm}[*]	N_{max} /% of G_{mm}[*]	
0.3	6 / ≤ 91.5	50 / 96.5	75 / ≤ 98	70 – 80 **
0.3 to < 3	7 / ≤ 90.5	75 / 96.5	115 / ≤ 98	70 – 80
3 to < 30	8 / ≤ 89	100 / 96.5	160 / ≤ 98	70 – 80
≥ 30	9 / ≤ 89	125 / 96.5	205 / ≤ 98	70 – 80

* G_{mm}: Theoretical maximum specific gravity of mix. Refer to AASHTO T 209.

** Use 67 percent for the lower limit VFA for 1-inch nominal maximum size mixture.

Table 8

Volumetric Design Requirements	
HMA design mixing and compaction temperatures	Provided by the Engineer
Dust Proportion Range	0.6 - 1.40
Voids in Mineral Aggregate (VMA) at N _{design} AASHTO R 35.9.2 using G _{sb} Oven Dry. Equation based on percent of total mix.	12.0% - 13.0% for 1 inch 13.0% - 14.0% for ¾ inch 14.0% - 15.0% for ½ inch 15.0% - 16.0% for ⅜ inch
Hamburg Wheel Tracker UDOT MOI 990	75 Design Gyration and Greater Maximum 10 mm impression at 20,000 passes. Less than 75 Design Gyration Maximum 10 mm impression at 10,000 passes

2.6 PRIME COAT/TACK COAT

- A. Refer to Section 02748.

PART 3 EXECUTION

3.1 HMA

- A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight.
 - 1. May be verified by AASHTO T 255.
 - 2. Adjust burners to avoid damage or soot contamination of the aggregate.
- B. Treat aggregate with hydrated lime. Refer to Section 02746.
 - 1. Method A or B
 - 2. The Department applies a deduction for mix produced by a non-certified supplier to cover the costs of inspection.
 - a. The deduction is applied according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.
- C. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
 - 1. May be verified by AASHTO T 195.
 - 2. Discontinue operation and make necessary corrections if material is not properly coated.
- D. Maintain temperature of the HMA between the limits identified on the Volumetric Mix Design Verification Letter for mixing and compacting.
 - 1. The Department rejects materials heated over the identified limits.
 - 2. Remove all material rejected by the Department for overheating.
- E. Minimum compacted lift thickness is 3 times the nominal maximum aggregate size.

3.2 HMA PLANT

- A. Provide
 - 1. Positive means to determine the moisture content of aggregate.
 - 2. Positive means to sample all material components.
 - 3. Sensors to measure the temperature of the HMA at discharge.
 - 4. The ability to maintain mix discharge temperature according to the mix design.
- B. Asphalt Binder Storage Tanks
 - 1. Provide a positive means for separating and identifying asphalt grades when multiple products are used in mix production.
 - 2. Provide a positive means of sampling the asphalt binder.

- a. The Engineer determines a common sampling point where multiple products are used in mix production.

3.3 CEASE PRODUCTION

- A. Cease production when any two out of three consecutive lots meet one of the following criteria:
 1. A net disincentive
 2. Air voids at N_{des} averaged for each lot are less than 2.5 or greater than 4.75 percent
 3. VMA at N_{des} averaged for each lot are not within Target Value $\pm$ 1.25 percent
- B. Submit a corrective action plan for approval before production continues indicating the changes in production procedures that will be implemented to correct the deficiencies.
 1. Address the specific issues contributing to the cease production.
 2. Obtain approval of the revised plan before production continues.
- C. The Engineer may require a new mix design.
- D. The Engineer may require Hamburg Wheel-Track testing for up to 5 lots after the cease production order.
 1. Sample randomly from behind the paver for up to 5 lots after the cease production order.
 2. Failure to meet the requirements of Table 8 results in rejection of the lot.

3.4 LABORATORY CORRELATION

- A. Perform split-sample, paired t -testing with the Department based on project quality control testing using Department LQP qualified lab.
 1. Perform split-sample, paired t analysis on all mix acceptance tests and tests related to volumetric properties.
 2. Perform paired t analysis as defined in the UDOT Materials Manual of Instruction, Appendix C.
 3. Continue paired t -testing until at least two consecutive production days meet $\alpha = 0.05$ for a two tailed distribution.
 4. Resolve discrepancies in lab results within the first five production days.
 - a. Cease production if the requirements for two consecutive days of the first five days cannot be met.
 - b. Submit a corrective action plan to the Engineer before production continues indicating the changes in procedures that will be implemented to correct the deficiencies.

- 1) Both Contractor and Department labs must make paired *t* test results available within 24 hours of sampling.

3.5 SURFACE PREPARATION

- A. Locate, reference, and protect all utility covers, monuments, curb and gutter, and other components affected by the paving operations.
- B. Remove all moisture, dirt, sand, leaves, and other objectionable material from the prepared surface before placing the tack coat and mix.
- C. Complete spot leveling before placing pavement courses.
 1. Place, spread, and compact leveling mix on portions of the existing surface.
 2. Fill and compact any localized potholes more than 1 inch deep.
 3. Allow compacted mix to cool sufficiently to below 150 degrees F to provide a stable structural platform before placing additional lifts of HMA.
- D. Apply tack coat to all paved surfaces before applying a leveling course or pavement lift as required in Section 02748.
- E. Allow sufficient cure time for prime coat/tack coat before placing HMA.

3.6 SURFACE PLACEMENT

- A. Provide a compactable sloped edge adjacent to the next lane to be paved when full-width or Echelon paving is impractical and more than one pass is required.
 1. Coat edge with tack coat according to Section 02748 at a residual rate of 0.05 gal/yd².
 2. Echelon paving is the preferred method for constructing a longitudinal joint.
 3. Refer to Section 01554 and DD and TC Series Standard Drawings for pavement edge slope required to safely maintain traffic.
- B. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.
- C. Construct straight joints, offset longitudinal joints 6 to 12 inches in succeeding courses.
 1. Construct all joints within 1 ft of the centerline, the lane line or the center of the lane.
 2. Tack the longitudinal edge before placing the adjacent pass.

- D. Offset transverse construction joints at least 6 ft longitudinally.
- E. Do not allow construction vehicles, general traffic, or rollers to pass over the uncompacted end or edge of freshly placed mix until the mat temperature drops to a point where damage or differential compaction will not occur.
- F. Taper the end of a course subjected to traffic at approximately 50:1 (horizontal to vertical).
 - 1. Remove the portion of the pass that contains the tapered end before placing fresh mix.
 - 2. Tack the contact surfaces before fresh mix is placed against the compacted mix.
- G. Use a motor grader, spreader box, or other approved spreading methods for projects under 180 yd², irregular areas, or for miscellaneous construction such as detours, sidewalks, and leveling courses.

3.7 COMPACTION

- A. Use a small compactor or vibratory roller at structures in addition to normal rolling.
- B. Operate in a transverse direction next to the back wall and approach slab.

3.8 LIMITATIONS

- A. Do not place on frozen base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
- B. Use a release agent that does not dissolve asphalt and is satisfactory to the Engineer for all equipment and hand tools used to mix, haul, and place the HMA.
- C. Place HMA from April 15 through October 15, and when the air temperature in the shade and the roadway surface temperature is above 50 degrees F.
 - 1. The Department determines if it is feasible to place HMA outside these dates and temperature limits.
 - 2. Obtain authorization from the Engineer before paving outside these requirements.

END OF SECTION

Hot Mix Asphalt (HMA)
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SECTION 02743

HOT MIX ASPHALT – BIKE AND PEDESTRIAN PATHS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and procedures for constructing a surface course of one or more layers of HMA comprised of aggregate, asphalt binder, lime, and other additives for bike and pedestrian paths.
- B. Mix materials at a central mixing plant.

1.2 RELATED SECTIONS

- A. Section 02741: Hot Mix Asphalt (HMA)
- B. Section 02745: Asphalt Material
- C. Section 02746: Hydrated Lime
- D. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

- A. AASHTO T 11: Materials Finer Than 75 μm (No. 200) Sieve In Mineral Aggregates By Washing
- B. AASHTO T 19: Bulk Density (Unit Weight) and Voids in Aggregate
- C. AASHTO T 27: Sieve Analysis Of Fine and Coarse Aggregates
- D. AASHTO T 30: Mechanical Analysis of Extracted Aggregate
- E. AASHTO T 89: Determining the Liquid Limit of Soils
- F. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- G. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
- H. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

- I. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
- J. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- K. AASHTO T 209: Theoretical Maximum Specific Gravity and Density of Hot-Mix Asphalt Paving Mixtures
- L. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- M. AASHTO T 308: Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven
- N. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- O. UDOT Materials Manual of Instruction (MOI)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Design data sheet – Refer to this Section, article 1.6, paragraph A.

1.6 ACCEPTANCE

- A. Certify that the mix meets the gradation requirements of Table 2, aggregate gradation and asphalt binder requirements from the Job Mix Design Requirements. Refer to AASHTO T 30 and T 308.

PART 2 PRODUCTS

2.1 ASPHALT MATERIALS

- A. Use the following asphalt materials:
 - 1. Asphalt Binder – Performance Graded (PG) Binder.
 - 2. Flush Coat – CQS-1, CSS-1 or SS-1.

2.2 AGGREGATE

- A. Refer to Section 02745 and Section 02741 excluding Aggregate Properties Table.
- B. Use Table 1 following for Aggregate Properties.

Table 1

Aggregate Properties		
Properties	Test Method	Test Requirements
One Fractured Face	AASHTO T 335	N/A
Two Fractured Face	AASHTO T 335	90% Min.
Fine Aggregate Angularity	AASHTO T 304	45 Min.
Flakiness Index	MOI 933 Based on $\frac{3}{8}$ inch and above	17% Max.
L.A. Wear	AASHTO T 96	35% Max.
Sand Equivalent	AASHTO T 176	45 Min.
Plasticity Index	AASHTO T 89 and T 90	0
Unit Weight	AASHTO T 19	75 lb/ft ³ Min.
Soundness Loss	AASHTO T 104 – Sodium Sulfate	16% Max. loss with five cycles
Deleterious Materials	AASHTO T 112	2% Max.
Natural Fines	---	10% Max.

C. Meet gradation in Table 2.

Table 2

Aggregate Gradations Percent Passing by Dry Weight of Aggregate AASHTO T 11 and AASHTO T 27	
Control Sieve	Percent
$\frac{1}{2}$ inch	100.0
$\frac{3}{8}$ inch	90.0 - 100.0
# 4	< 90.0
# 8	32.0 - 67.0
#200	2.0 - 10.0

2.3 HYDRATED LIME

- A. Use at least one percent hydrated lime.
- B. Refer to Section 02746.

2.4 VOLUMETRIC DESIGN REQUIREMENTS

- A. Perform Superpave Volumetric Mix Design according to UDOT Materials Manual of Instruction 960 and the following:
 - 1. Incorporate hydrated lime into all designs. Refer to Section 02746.
 - 2. Comply with Table 3.
- B. The Department Region Materials Lab verifies the Volumetric Mix Design. Refer to UDOT Materials Manual of Instruction 960.
 - 1. Do not begin paving until verification is complete.
 - 2. The Region Materials Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design or from a previous mix design.
 - 3. The Region Materials Engineer reserves the right to verify any mix design submitted.

Table 3

Superpave Volumetric Mix Design		
Compaction Stage	Number of Gyration (N)	% of G_{mm} (AASHTO T 209)
Initial	5	≤ 91.5
Design	50	≥ 98.5
Maximum	75	≤ 100.0

PART 3 EXECUTION

3.1 HMA

- A. Refer to Section 02741, Part 3.

3.2 SURFACE PREPARATION

- A. Refer to Section 02741, Part 3.
- B. Refer to Section 02748.

3.3 COMPACTION

- A. Establish a rolling pattern to obtain maximum density without over-stressing the pavement.

3.4 ASPHALT EMULSION

- A. Apply the flush coat at a uniform rate of 0.10 gal/yd² undiluted emulsion or 0.15 gal/yd² 2:1 diluted emulsion.
 - 1. Diluted emulsion 2:1 represents two parts undiluted emulsion and one part water.

END OF SECTION

SECTION 02744

STONE MATRIX ASPHALT (SMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. A surface course of one or more layers of fiber stabilized SMA comprised of aggregate, asphalt binder, hydrated lime, and other additives.

1.2 RELATED SECTIONS

- A. Section 02701: Pavement Smoothness
- B. Section 02742S: Project Specific Surfacing Requirements
- C. Section 02745: Asphalt Material
- D. Section 02746: Hydrated Lime
- E. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

- A. AASHTO M 325: Stone Matrix Asphalt (SMA)
- B. AASHTO R 46: Designing Stone Matrix Asphalt (SMA)
- C. AASHTO R 67: Sampling Asphalt Mixtures after Compaction (Obtaining Cores)
- D. AASHTO T 11: Materials Finer Than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
- E. AASHTO T 19: Bulk Density ("Unit Weight") and Voids in Aggregate
- F. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- G. AASTHO T 85: Specific Gravity and Absorption of Coarse Aggregate
- H. AASHTO T 89: Determining the Liquid Limit of Soils
- I. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

- J. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact of the Los Angeles Machine
- K. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- L. AASHTO T 112: Clay Lumps and Friable Particles in Aggregate
- M. AASHTO T 166: Bulk Specific Gravity (G_{mb}) of Compacted Hot Mix Asphalt (HMA) Using Saturated-Surface Dry Specimens
- N. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- O. AASHTO T 195: Determining Degree of Particle Coating of Asphalt Mixtures
- P. AASHTO T 209: Theoretical Maximum Specific Gravity (G_{mm}) and Density of Hot Mix Asphalt (HMA)
- Q. AASHTO T 255: Total Evaporable Moisture Content of Aggregate by Drying
- R. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- S. AAHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
- T. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- U. AASHTO T 305: Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
- V. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- W. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- X. UDOT Materials Manual of Instruction.
- Y. UDOT Minimum Sampling and Testing Requirements
- Z. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Lot – The number of tons of SMA placed in a Production Day.
- B. Minor Target Change – A change from the verified mix design gradation target on a maximum of two sieves with the following limitations.
 - 1. The maximum change in the target gradation on the No. 8 or any coarser sieve is limited to 3 percent passing per sieve.
 - 2. The maximum change in the target gradation on the No. 50 sieves is 2 percent passing per sieve.
 - 3. The maximum change in the target gradation on the No. 200 sieve is 0.5 percent passing.
 - 4. No target change may violate the mix design requirements in this Section.
- C. Production Day – A 24 hour period in which SMA is being placed.

1.5 SUBMITTALS

- A. Mix design for approval at least 10 working days before paving according to the UDOT Materials Manual of Instruction 962.
- B. Changes in job mix design
 - 1. Submit a written request for a proposed change in the job-mix gradation.
 - a. Allow at least 12 hours for approval before incorporating a minor target change into production.
 - b. Allow at least six working days for verification and approval of any other change.
 - 2. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements.
 - a. Department acceptance test results or Contractor QC test data or both are acceptable.
 - 3. Submit samples according to the UDOT Materials Manual of Instruction 962 for a volumetric mix design verification for anything other than approved minor target change.
 - a. This includes changes in the aggregate source, asphalt binder source, or asphalt binder grade.
- C. Corrective action plan according to this Section, Article 3.3.
- D. Refer to this Section, Article 1.7 for laboratory correlation submittals.
- E. Mat joint layout plan to the Engineer for review at least 10 calendar days before placement.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. Gradation and asphalt binder content
 - 1. The Engineer evaluates a lot on the test results of four samples with the following exceptions:
 - a. Compute incentive/disincentive using the test results from three samples if only three samples can be taken for the production day.
 - b. Combine test results with the next day of production if at least three random samples cannot be taken. Take one sample for each 500 tons, or portion thereof, from the following day's production.
 - c. Add the lot to the previous day's production for the final day's production if three random samples cannot be taken.
 - d. The lot may be increased to include up to three production days when agreed upon in advance by both the Contractor and the Engineer when less than 900 tons are anticipated per production day.
 - 2. Evaluate the lot using the number of tests "n" in Table 3.
 - 3. The Engineer informs the Contractor of the time and place of sampling not more than 15 minutes before sampling.
 - 4. Increase sample sizes to accommodate paired-T testing as required.
- C. Density and Thickness
 - 1. Obtain cores within two contract days after the pavement is placed. Refer to AASHTO R 67.
 - a. The Engineer marks coring location for in-place density.
 - b. Move transversely to a point 1 ft from the edge of the pavement for in-place density if the random location for coring falls within 1 ft of the edge of the overall pavement section (outer part of shoulders).
 - c. Fill core holes with SMA mix and compact.
 - d. The Department witnesses the coring operation, takes possession of the cores immediately, and begins testing the cores within 24 hours for density acceptance.
 - 2. Density Requirements
 - a. The target for in-place density is 94.0 percent of Theoretical Maximum Specific Gravity
 - b. Use the average of the Theoretical Maximum Specific Gravity tests for each lot.

3. Thickness Requirements
 - a. The Department accepts a lot for thickness when:
 - 1) The average thickness is not more than $\frac{1}{2}$ inch greater or $\frac{1}{4}$ inch less than the total design thickness specified.
 - 2) No individual subplot shows a deficient thickness of more than $\frac{3}{8}$ inch.
 - b. Excess Thickness – The Engineer may allow excess thickness to remain in place or may order its removal.
 - 1) The Department pays for 50 percent of the mix for material in excess of the $+\frac{1}{2}$ inch tolerance when excess thickness is allowed to remain in place.
 - 2) Remove and replace the entire depth of the course if it is necessary to remove portions of the course.
 - c. Deficient Thickness – Place additional material where lots or sublots are deficient in thickness.
 - 1) The Department pays for material necessary to reach specified thickness.
 - 2) The Department pays for 50 percent of the mix for additional material over specified thickness necessary to achieve minimum lift thickness.
 - 3) Minimum compacted lift is 3 times the nominal maximum aggregate size.
 - d. Thickness tolerances established above do not apply to leveling courses.
 - 1) Check final surfaces in stage construction.
 - e. Thickness acceptance for thin overlay pavement consists of checking thickness regularly with a depth probe during placement and taking corrective action as necessary.

- D. The Department applies incentive/disincentive for Gradation/Asphalt Content, and In-Place Density. The Engineer computes Incentive/Disincentive for each lot.
 1. Compute incentive/disincentive for Gradation/Asphalt Binder and In-place Density according to Table 1.
 2. Base the incentive/disincentive on Percent within Limit (PT) computation using Tables 2, 3, and 4.
 3. Use lowest single value combined for gradation (each of the sieves) and asphalt binder content for calculating the gradation/asphalt binder content incentive/disincentive.
 4. Use Tables 2, 3, and 4 to determine PT for in-place density.
 5. Meet PT of 88 or greater for in-place density or the Department does not pay incentives on gradation/asphalt binder content.

6. Meet control requirements of Table 2 for VMA and VCA.
 - a. VCA_{MIX} is less than VCA_{DRC} or the Department does not pay incentive for gradation/asphalt binder content.
 7. The following work is not eligible for incentive:
 - a. Items such as utility work, traffic signals, detours, lane leveling, and driveways.
 - b. Small projects with plan quantities of HMA less than 500 tons.
- E. The Department applies incentive/disincentive for smoothness according to Section 02701.
1. Refer to Section 02701 for smoothness requirements.
- F. The Department rejects lots:
1. If the PT for any individual gradation measurement listed in Table 3 is less than 60 percent.
 2. If the PT for asphalt binder content or density is less than 52 percent.
 3. The Engineer may accept a reject lot. Refer to Section 01456.
 - a. A price reduction of 35 percent of the pay item or \$30 per ton, whichever is greater, will be assessed.
 - b. The lot will not be eligible for any incentive.
- G. The Engineer may elect to accept material on visual inspection for work such as utility work, traffic signals, detours, lane leveling, and driveways, other hand work, or small projects with plan quantities less than 500 tons.
1. Lots accepted on visual inspection are not eligible for Incentive/Disincentive.
 2. The Engineer reserves the option of conducting acceptance tests necessary to determine the material and workmanship meets the project requirements.
 3. Acceptance for density may be based on establishing and maintaining a roller pattern to obtain maximum density without over-stressing the pavement.

Table 1

Incentive/Disincentive for Asphalt Binder Content, and Density	
PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	2.50
96-99	2.00
92-95	1.25
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
<60	Reject
Incentive/Disincentive for Gradation	
PT Based on Min. Four Samples	Incentive/Disincentive (Dollars/Ton)
>99	2.50
96-99	2.00
92-95	1.25
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
56-59	-5.00
52-55	-10.00
<52	Reject

Table 2

Production Control for VMA and VCA_{MIX}		
VMA Average Value, x, (%) Minimum of three Samples	VCA_{MIX} Job-Mix Design	Action
$X \geq 16.5$ and $X \leq 18.5$	$VCA_{MIX} < VCA_{DRC}$	Continue Paving
$X < 16.5$ or $X > 18.5$	$0 < VCA_{MIX} - VCA_{DRC} \leq 0.5\%$	Stop Production until a corrective action plan is approved.
$X < 15.5$ or $X > 19.5$	$0.5 < VCA_{MIX} - VCA_{DRC}$	Stop Production and resubmit Mix Design

Table 3

Upper and Lower Limit Determination	
Parameter	UL and LL
$3/8$ " sieve for $1/2$ " SMA	Target Value $\pm 5.0\%$
#4 sieve	Target Value $\pm 4.0\%$
# 8 sieve	Target Value $\pm 3.0\%$
# 50 sieve	Target Value $\pm 3.0\%$
# 200 sieve	Target Value $\pm 2.0\%$
Asphalt Binder Content	Target Value $\pm 0.35\%$
Density	Lower Limit: Target Value - 2.0% Upper Limit: Target Value + 3.5%

Enter table in the appropriate sample size column and round down to the nearest value.

Table 4

Quality Index Values (QU or QL) for Estimating Percent Within Limits										
PU or PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24	0.23	0.23	0.23

Table 4 Continued										
PU/PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21	0.21	0.20
57	0.25	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18
56	0.22	0.18	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.15
55	0.18	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.04	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

Table 5

Definitions, Abbreviations, and Formulas for Acceptance	
Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content are given in the CONTRACTOR's mix design. The target value for density is 94.0 percent of maximum (Rice) density.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.
Standard Deviation (s)	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE, divided by the number of test results minus one. This statement does not limit the methods of calculations of s; other methods that obtain the same value may be used.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 3)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 3)
Upper Quality Index (QU)	$QU = (UL - AVE)/s$
Lower Quality Index (QL)	$QL = (AVE - LL)/s$
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot (PL) Within UL and LL (PT)	$PT = (PU + PL) - 100$
Incentive/Disincentive	Determined by entering Table 1 with PT or PL.

Values for AVE, s, QU, and QL will be calculated to a minimum two decimal place accuracy that will be carried through all further calculations. Rounding to lower accuracy is not allowed.

1.7 LABORATORY CORRELATION

- A. Perform the following to be eligible for dispute resolution:
 - 1. Perform split-sample, paired *t*-testing with the Department based on project quality control testing using UDOT LQP qualified lab.
 - a. Perform split-sample, paired-*t* analysis on all mix acceptance tests related to volumetric properties and the following background testing:
 - 1) Maximum Theoretical Specific Gravity of Mix (G_{mm}), AASHTO T 209
 - 2) Bulk Specific Gravity of Mix (G_{mb}), AASHTO T 166
 - 3) Bulk Specific Gravity of Coarse Aggregates (G_{sb}), AASHTO T 85
 - b. Continue until attaining successful paired *t*-test results, meeting $\alpha = 0.05$, for a minimum of two consecutive production days (UDOT Materials Manual of Instruction, Part 8, Appendix C).
 - c. The engineer may require that all QC testing data be received before disclosure of the QA testing results. This applies to paired *t*-test and all subsequent QA/QC testing data.
- B. Submit a detailed report showing tabular summaries of daily test data, paired *t*-testing calculations and any corrections made to account for failed comparisons.
- C. Submit summary before submitting engineering analysis for dispute resolution.

1.8 DISPUTE RESOLUTION

- A. Refer to Section 01456 when disputing the validity of the Department's acceptance tests.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

- A. Project Specific Surfacing Requirements – Refer to Section 02742S.
- B. Asphalt Material – Refer to Section 02745 and Quality Management Plan 509: Asphalt Binder

- C Use the minimum asphalt binder content specified in Table 10 unless called out differently in 02742S for the project.

2.2 AGGREGATE

- A. Use crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
- B. Refer to Table 6, to determine the suitability of the aggregate.
1. Coarse aggregates:
 - a. Retained on No. 4 sieve. AASHTO T 27
 2. Fine aggregates:
 - a. Clean, hard grained, and angular.
 - b. Passing the No. 4 sieve. AASHTO T 27

Table 6

Test Method	Test No.	Specification
One Fractured Face	AASHTO T 335	100% min.
Two Fractured Face	AASHTO T 335	90% min.
Fine Aggregate Angularity	AASHTO T 304	45 min.
Flakiness Index	UDOT MOI (Based on 3/8 inch and above)	25% max.
L.A. Wear	AASHTO T 96	28% max.
Sand Equivalent	AASHTO T 176 (Pre-wet method)	60 min.
Plasticity Index (Does not apply to Mineral Filler)	AASHTO T 89 and T 90	0 max.
Unit Weight	AASHTO T 19	75 lb/cu. ft. min.
Polishing*	AASHTO T 278 and T 279	31 min.
Soundness (sodium sulfate)	AASHTO T 104	10% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max
Natural Fines	N/A	0 max.
* The Department has the right to waive this requirement if the aggregates have proven acceptable through successful past performance as determined by the Engineer.		

- C. Meet the gradation requirements in Table 7. (AASHTO T 11, AASHTO T 27)

Table 7

Control Sieve Size	½ inch	¾ inch
¾ inch	100	100
½ inch	90 - 100	100
¾ inch	45 - 78	90 - 100
No. 4	20 - 28	26 - 50
No. 8	16 - 24	20 - 28
No. 16	13 - 21	13 - 21
No. 30	12 - 18	12 - 18
No. 50	12 - 15	12 - 15
No. 200	8 - 10	8 - 10

2.3 ADDITIVES / STABILIZERS

- A. Hydrated Lime: Meet the requirements of Section 02746.
- B. Stabilizing additive: Made from virgin basalt, diabase, slag, or cellulose treated with a cationic sizing agent to enhance disbursement of the fiber as well as increase adhesion of the fiber surface with the asphalt binder and control drain-down. Meet AASHTO M 325.
1. Mineral Fiber
 - a. Dosage rate between 0.3 percent to 0.6 percent, by weight of the total mix.
 - b. Average fiber length 0.25 inches, maximum
 - c. Average Fiber thickness 0.0002 inches, maximum
 - d. Shot content (ASTM C 612)
Passing No. 60 sieve 90 – 100 percent
Passing No. 230 sieve 65 – 100 percent
 2. Cellulose Fiber
 - a. Dosage rate for cellulose is 0.2 percent to 0.4 percent by weight of total mix.
 - b. Using Alpine sieve analysis, fiber length of 0.25 inches maximum passing the No. 100 sieve 70 percent (± 10 percent).

- c. Using a mesh screen analysis, fibers will pass
No. 20 sieve 85 percent (± 10 percent)
No. 40 sieve 65 percent (± 10 percent)
No. 140 sieve 30 percent ± 0 percent)
- d. Ash content will be 18 percent (± 5 percent)
- e. PH will be 7.5 (± 1.0)
- f. Oil absorption will be 5.0 (± 1.0 percent)
- g. Moisture content will be <5 percent by weight of cellulose

C. Mineral Filler:
Consists of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, fly ash, or other suitable mineral matter. Free flowing and free of lumps.

1. Meet the following requirements:

Table 8

Sieve Size	Percent Passing
No. 30	100
No. 50	95 – 100
No. 200	55 – 100
No. 450	40 max.

2. No organic impurities
3. Plasticity Index less than 4 (not appropriate for hydrated lime and hydraulic cement)

2.4 JOB-MIX DESIGN

- A. Perform Stone Matrix Asphalt Mix Design according to UDOT Manual of Instruction 962.
 1. Submit for verification at least 10 working days before beginning paving.
 2. Do not begin paving until verification is complete.
- B. Meet the following requirements:

Table 9

Mix Design Compaction Parameters	
Design Gyration	% of G_{mm}^*
100	96.5

* G_{mm} : Maximum theoretical specific gravity of mix.

Table 10

Minimum Asphalt Binder Content	
Combined Aggregate Bulk Specific Gravity Including Lime G_{sb}	Minimum Asphalt Binder Content %*
2.375 - 2.424	6.8
2.425 - 2.474	6.7
2.475 - 2.524	6.6
2.525 - 2.574	6.5
2.575 - 2.624	6.3
2.625 - 2.674	6.2
2.675 - 2.724	6.1
> 2.724	6.0
* Percent of total mix.	

Table 11

Mix Design Requirements	
SMA design mixing and compaction temperatures	Provided by the Engineer
Voids in Mineral Aggregate (VMA) AASHTO R 46, using G_{sb} . Equation based on percent of total mix.	17.0% min.
Voids In Course Aggregate (Stone Matrix Asphalt Mix Design)	$VCA_{MIX} < VCA_{DRC}$
Hamburg Wheel Tracker	< 10.00 mm at 20,000 Cycles.
Draindown (AASHTO T 305)	0.30 max.

- C. Mortar must meet the following. Refer to UDOT Materials Manual of Instruction 962.
1. Unaged DSR $G^*/\sin \delta \geq 5$ kPa
 2. RTFO aged DSR $G^*/\sin \delta \geq 11$ kPa
 3. PAV aged BBR Stiffness ≤ 1500 Mpa

2.5 CONTRACTOR INITIATED CHANGES IN STONE MATRIX ASPHALT MIX DESIGN

- A. Submit requests in writing to the Engineer at least 12 hours before incorporating changes into production.

- B. Submit a field volumetric mix design for all target changes.
 - 1. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Department acceptance or Contractor QC testing data is acceptable.
 - 2. Field volumetric mix design verification consists of three sets of two gyratory specimens run at the new target gradation, asphalt binder content, or both.
 - a. The Department's previous acceptance tests are acceptable for field verification.
 - 3. The Engineer, in consultation with the Region Materials Engineer, provides written concurrence of the verified field volumetric mix design if the field volumetric mix design meets the volumetric requirements.
 - 4. Submit a new laboratory volumetric mix design from a laboratory qualified by UDOT Central Materials if the field volumetric mix verification does not meet the volumetric requirements.
 - a. Allow at least 7 working days for verification.
 - 5. The Department may allow up to two minor target changes per project without penalty to the Contractor.
 - a. The Department charges \$1,000 for each additional minor target change.
 - 6. The Department performs up to two volumetric mix design verifications at no cost to the Contractor.
 - a. The Department charges \$3,000 for each additional laboratory or field verification required including all laboratory or field volumetric mix design verifications required due to contractor initiated target changes.
- C. Submit a new laboratory volumetric mix design if changes occur in the aggregate source, asphalt binder source, or grade.
- D. Do not make changes to production mix until request is reviewed and verified by the Resident Engineer in consultation with the Region Materials Engineer.

PART 3 EXECUTION

3.1 SMA

- A. Dry aggregate to an average moisture content of not more than 0.2 percent by weight.
 - 1. May be verified by AASHTO T 255.
 - 2. Adjust burners to avoid damage or soot contamination of the aggregate.

- B. Treat aggregate with hydrated lime. Refer to Section 02746.
 - 1. Use method A or B.
 - 2. The Department applies a deduction for mix produced by a non-certified supplier to cover the costs of inspection.
 - 3. The deduction is applied according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.
- C. Coat with asphalt binder 100 percent of the particles passing and 98 percent of the particles retained on the No. 4 sieve.
 - 1. May be verified by AASHTO T 195.
 - 2. Discontinue operation and make necessary corrections if material is not properly coated.
- D. Maintain temperature of the SMA between identified compaction limits as defined on Volumetric Mix Design Verification Letter.
 - 1. The Department rejects materials heated over the identified limits.
 - 2. Remove all material rejected by the Department for overheating.

3.2 SMA PLANT

- A. Provide the following:
 - 1. Positive means to determine the moisture content of aggregate on a daily basis.
 - 2. Positive means to sample all material components.
 - 3. Sensors to measure the temperature of the SMA at discharge.
 - 4. The ability to maintain discharge temperature of the mix according to the mix design.
- B. Asphalt Binder Storage Tanks:
 - 1. Provide positive means of determining the quantity of material in the tank at any time.
 - 2. Provide positive means of sampling the asphalt binder from the tanks.
- C. Fiber Supply System:
 - 1. Provide a separate proportioning device interlocked with the aggregate feed or weigh system to maintain correct proportions and uniform distribution for all rates of production and batch sizes.
 - 2. Provide flow indicators or sensing devices interlocked with plant controls.
 - 3. Uniformly distribute fibers in aggregate before injecting the asphalt into the mixer. (8 to 12 seconds)
 - 4. Do not allow the fiber to become entrained in the exhaust system of the plant.

- D. Mineral Filler Supply System:
 - 1. Provide a separate proportioning device interlocked with the aggregate feed or weigh system to maintain correct proportions and uniform distribution for all rates of production and batch sizes.
 - 2. Provide flow indicators or sensing devices interlocked with plant controls.
 - 3. Uniformly distribute filler in aggregate before injecting asphalt into the mixer.
 - 4. Do not allow the filler to become entrained in the exhaust system of the plant.

3.3 CEASE PRODUCTION

- A. Cease production when any two out of three consecutive lots meet one of the following criteria:
 - 1. A net disincentive.
 - 2. Air voids averaged for each lot are less than 2.5 or greater than 4.5 percent.
 - 3. Refer to Table 2 of this section.
- B. Submit a corrective action plan to the Engineer before production continues indicating the changes in production procedures that will be implemented to correct the deficiencies.
 - 1. Address the specific issues contributing to the cease production directive.
 - 2. The Engineer must approve the revised plan before production continues.
- C. The Engineer may require a new mix design.

3.4 SURFACE PREPARATION

- A. Locate, reference, and protect all utility covers, monuments, curb and gutter, and other components affected by the paving operations.
- B. Remove all moisture, dirt, sand, leaves, and other objectionable material from the prepared surface before placing the mix.
- C. Allow sufficient cure time for prime coat/tack coat before placing SMA. Refer to Section 02748.

3.5 SURFACE PLACEMENT

- A. Provide a 3:1 (horizontal to vertical) sloped edge adjacent to the next lane to be paved when full-width or echelon paving is impractical and more than one pass is required.

- B. Construct the longitudinal joint to within 6 inches of the lane lines or at the center of the lane at the direction of the Engineer, but never in a wheel path.
 - 1. Core and test all longitudinal joints for compaction according to the specification if the lift is 2 or more inches thick.
 - 2. Verify all edges of the adjacent areas to through lanes have straight and uniform longitudinal lines and neat vertical edges.
 - 3. Fill core holes with SMA mix and compact.
- C. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.
- D. Do not allow construction vehicles, general traffic, or rollers to pass over the uncompacted end or edge of freshly placed mix until the mat temperature drops to a point where damage or differential compaction will not occur.
- E. Taper the end of a course subjected to traffic at approximately 50:1 (horizontal to vertical).
 - 1. Make a transverse joint by saw or wheel cutting and removing the portion of the pass that contains the tapered end.
 - 2. Tack the contact surfaces before fresh mix is placed against the compacted mix.
- F. Use a Material Transfer Vehicle (MTV) to apply all courses of SMA. Use an MTV that internally performs additional mixing of the SMA mix and then deposits material into the paver at a uniform temperature and consistency.
 - 1. Use other approved means to deposit material into the paver when an MTV is impractical, placements such as utility work, traffic signals, detours, lane leveling, and driveways, side street tie-ins, other hand work, or small projects with plan quantities less than 500 tons.

3.6 COMPACTION

- A. Use a small compactor or vibratory roller in addition to normal rolling at structures.
- B. Operate in a transverse direction next to the back wall and approach slab.
- C. Use a 9 ton (minimum) roller.

- D. Roll surface immediately after placement staying as close as possible to the lay-down machine and assuring proper mix design placement temperatures.
 - 1. Minimize the use of vibratory rollers.
- E. Do not use full Pneumatic tire rollers.
- F. Discontinue vibration if aggregate breakdown occurs or if bleeding occurs.

3.7 LIMITATIONS

- A. Do not place SMA on frozen base or subbase.
- B. Use a release agent that does not dissolve asphalt and is satisfactory to the Engineer for all equipment and hand tools used to mix, haul, and place the SMA.
- C. Do not place SMA during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
- D. Place SMA from April 15, to October 15, and when the air temperature in the shade and the roadway surface temperature are above 50 degrees F.
 - 1. The Department determines if it is feasible to place SMA outside these dates and temperature.
 - 2. Obtain authorization from the Engineer before paving outside these limits.

END OF SECTION

SECTION 02745

ASPHALT MATERIAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Asphalt materials binders, emulsions and crack sealant for pavements.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 81: Cutback Asphalt (Rapid-Curing Type)
- B. AASHTO M 82: Cutback Asphalt (Medium-Curing Type)
- C. AASHTO M 140: Emulsified Asphalt
- D. AASHTO M 208: Cationic Emulsified Asphalt
- E. AASHTO M 226: Viscosity Graded Asphalt Cement
- F. AASHTO M 282: Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements
- G. AASHTO M 320: Performance Graded Asphalt Binder
- H. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
- I. AASHTO T 44: Solubility of Bituminous Materials
- J. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup
- K. AASHTO T 49: Penetration of Bituminous Materials
- L. AASHTO T 50: Float Test for Bituminous Materials
- M. AASHTO T 51: Ductility of Bituminous Materials
- N. AASHTO T 59: Emulsified Asphalt
- O. AASHTO T 201: Kinematic Viscosity of Asphalts (Bitumens)

- P. AASHTO T 228: Specific Gravity of Semi-Solid Asphalt Materials
- Q. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
- R. AASHTO T 300: Force Ductility of Asphalt Materials
- S. AASHTO T 301: Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
- T. AASHTO T 313: Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
- U. AASHTO T 314: Determining the Fracture Properties of Asphalt Binder in Direct Tension
- V. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
- W. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer
- X. ASTM D 2006: Method for Characteristic Groups in Rubber Extender and Processing Oils by the Precipitation Method.
- Y. ASTM D 2007: Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum Derived Oils by the Clay Gel Absorption Chromatographic Method
- Z. ASTM D 2026: Cutback Asphalt (Slow Curing Type)
- AA. ASTM D 4402: Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
- BB. ASTM D 5329: Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements
- CC. ASTM D 5801: Toughness and Tenacity of Bituminous Materials
- DD. California Test Methods
- EE. UDOT Materials Manual of Instruction
- FF. UDOT Minimum Sampling and Testing Requirements (MS&TR)

1.4 DEFINITIONS

- A. Binder lot – Refer to MS&TR 02745.
- B. Compliance Limit – The limit for acceptance without price reductions, accounting for testing variability, for the listed properties.
- C. Composite Price Reduction – The sum of price reductions for all individual properties associated with a single asphalt binder sample.
- D. Rejection Limit – The limit for acceptance with price reductions. Material not meeting these limits will be rejected and removed and replaced.

1.5 SUBMITTALS

- A. A vendor prepared bill of lading for information showing the following for each material shipment:
 - 1. Type and grade of material
 - 2. Type and amount of additives used, if applicable
 - 3. Destination
 - 4. Consignee's name
 - 5. Date of Shipment
 - 6. Railroad car or truck identification
 - 7. Project number
 - 8. Loading temperature
 - 9. Net weight in tons or net gallons corrected to 60 degrees F, when requested
 - 10. Specific gravity
 - 11. Bill of lading number
 - 12. Manufacturer of asphalt material

1.6 ACCEPTANCE

- A. The Department accepts, rejects, or applies price reductions to all mix lots for performance-graded asphalt binder (PGAB) lots according to the compliance and rejection limits of Table 1, the Minimum Sampling and Testing Requirements, UDOT Quality Management Plan 509, and the associated mix specification.
 - 1. Rejected mix will be covered according to the associated mix specification including removal or if left in place the associated disincentive dollar amount for the rejected mix.

2. Material not meeting the compliance limit, but within the rejection limit, the price reduction applied to the mix pay item price is calculated as follows:
$$\text{Price Reduction (\%)} = 25 * \frac{(\text{Compliance Limit} - \text{Test Result})}{(\text{Compliance Limit} - \text{Rejection Limit})}$$
 3. The composite price reduction will be calculated by summing the price reduction for each parameter if more than one parameter lies outside specification limits.
 - a. The mix material will be rejected if the composite price reduction exceeds 25%.
- B. The maximum composite price reduction from the tested samples is applied to the mix in the binder lot if multiple samples from the binder lot are tested.
- C. Adjacent samples in the preceding, current, or subsequent lots may be tested to assess the extent and limit the amount of mix to be rejected if a binder lot is rejected.

Table 1

Specification, Compliance, and Rejection Limits for Performance-Graded Asphalt Binders (Applied to the Mix)			
Property	Specification Limit	Compliance Limit	Rejection Limit
G*/sinδ of the original PGAB at high grade temp, (kPa) Rule of 86 or lower	1.00 Min	0.84 Min	0.70 Min
G* of the original PGAB at high grade temp, (kPa)	1.30 Min	1.25 Min	1.11 Min
δ (phase angle) of the original PGAB at high grade temperature, (degrees C). Rule of 92 Binders Rule of 98 Binders	74.0 Max 71.0 Max	75.0 Max 72.0 Max	77.0 Max 74.0 Max
G*/sinδ of the RTFO Residue, (kPa)	2.20 Min	1.87 Min	1.53 Min
G*/sinδ of the PAV Residue, (kPa)	5000 Max	5250 Max	5700 Max
Stiffness of the PAV Residue at the specified low grade temperature +10°C, (MPa)	300 Max	311 Max	355 Max
Slope (m-value) of the Creep Curve at the specified low grade temperature +10°C	0.300 Min	0.295 Min	0.266 Min
Failure Strain of PAV Residue in Direct Tension at the specified low grade temperature +10°C, (%) Rule of 92, 98, or 104 Binders	1.500 Min	1.400 Min	1.200 Min
Failure Stress of PAV Residue in Direct Tension at the specified low grade temperature +10°C, (MPa) Rule of 92, 98, or 104 Binders	4.00 Min	4.00 Min	3.50 Min
Elastic Recovery of RTFO Residue, (%) Rule of 92 Binders Rule of 98 Binders Rule of 104 Binders	65 Min 70 Min 75 Min	60 Min 65 Min 70 Min	50 Min 55 Min 60 Min

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Each shipment of asphalt material must:
 - 1. Be uniform in appearance and consistency.
 - 2. Show no foaming when heated to the specified loading temperature.
- B. Do not supply shipments contaminated with other asphalt grades or materials.

1.8 GRADE OF MATERIAL

- A. The Engineer determines the grade of material to be used based on the supply source designated by the Contractor when the bid proposal lists more than one grade of asphalt material.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADED ASPHALT BINDER (PGAB)

- A. Use a qualified supplier according to the UDOT Quality Management Plan 509, Asphalt Binder.
- B. Refer to AASHTO M 320 for all PGABs having algebraic differences less than 92 degrees between the high and low design temperatures.
- C. Refer to AASHTO M 320 modified by Tables 2, 3, 4, 5, 6, 7, 8 and 9 for all PGABs having algebraic differences equal to or greater than 92 degrees between the high and low design temperatures.

Table 2

PG58-34		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 58° C, G*, kPa	1.30 Min.
	@ 58° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 58° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100° C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 16° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	1.5 Min.
	@ -24° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 3

PG64-28		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*, kPa	1.30 Min.
	@ 64° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 22° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	1.5 Min.
	@ -18° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 4

PG64-34		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*, kPa	1.30 Min.
	@ 64° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T-240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 64° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 19° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	1.5 Min.
	@ -24° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 5

PG70-22		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	74.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 28° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -12° C, S, MPa	300 Max.
	@ -12° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -12° C, Failure Strain, %	1.5 Min.
	@ -12° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 6

PG70-28		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 25° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	1.5 Min.
	@ -18° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 7

PG70-34		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*, kPa	1.30 Min.
	@ 70° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135 °C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 70° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	75 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 22° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -24° C, S, MPa	300 Max.
	@ -24° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -24° C, Failure Strain, %	1.5 Min.
	@ -24° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 8

PG76-22		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*, kPa	1.30 Min.
	@ 76° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 31°C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -12° C, S, MPa	300 Max.
	@ -12° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -12° C, Failure Strain, %	1.5 Min.
	@ -12° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

Table 9

PG76-28		
<u>Original Binder</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*, kPa	1.30 Min.
	@ 76° C, phase angle, degrees	71.0 Max.
Rotational Viscometer, AASHTO T 316	@ 135° C, Pa.s	3 Max.
Flash Point, AASHTO T 48	°C	260 Min.
<u>RTFO Residue, AASHTO T 240</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 76° C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	75 Min.
<u>PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28</u>		
Dynamic Shear Rheometer, AASHTO T 315	@ 28° C, kPa	5,000 Max.
Bending Beam Rheometer, AASHTO T 313	@ -18° C, S, MPa	300 Max.
	@ -18° C, m-value	0.300 Min.
Direct Tension Test, AASHTO T 314	@ -18° C, Failure Strain, %	1.5 Min.
	@ -18° C, Failure Stress (b), MPa	4.0 Min.
(a) Modify paragraph 4.5 as follows: Stop the ductilometer after 20 cm has been reached and within 2 seconds. Sever the specimen at its center with a pair of scissors.		
(b) No allowances will be given for passing at a colder grade.		

2.2 ASPHALTIC CEMENT, LIQUID ASPHALTS, AND REJUVENATING AGENTS

A. Refer to AASHTO M 226, Table 2 with the following modifications:

1. Delete and replace ductility at 77 degrees F (25 degrees C) with ductility at 39.2 degrees F (4 degrees C) using the values specified below.

AC - 2.5
50+

AC - 5
25+

AC - 10
15+

AC - 20
5+

B. Cationic and Anionic Emulsified Asphalt

1. All standard Slow Setting (SS, CSS), Quick Setting (QS, CQS) Medium Setting (MS, CMS), and Rapid Setting (RS, CRS) grades including all High-Float designations (HF).
2. Supply under the Approved Supplier Certification System (ASC).
3. Refer to and meet AASHTO M 208 and M 140.

C. Meet the requirements of one of these tables:

1. Table 10 – Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)
2. Table 11 – Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)
3. Table 12 – Cationic Medium Setting Emulsified Asphalt (CMS-2S)
4. Table 13 – High Float Medium Setting Emulsified Asphalt (HFMS-2)

5. Table 14– High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P)
 6. Table 15 – High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2SP)
 7. Table 16 – High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P).
 8. Table 17 –Cationic Rapid Setting Emulsified Asphalt (CRS-2A, B)
- D. Curing Cut-Back Asphalt
1. Refer to specification ASTM D 2026 for slow curing (SC).
 2. Refer to specification AASHTO M 82 for medium curing (MC).
 3. Refer to specification AASHTO M 81 for rapid curing (RC).
- E. Meet the requirements for Emulsified Asphalt Pavement Rejuvenating Agent:
1. Table 18 – Type A
 2. Table 19 – Type B
 3. Table 20 – Type B Modified
 4. Table 21– Type C
 5. Table 22 – Type D

Table 10

Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)			
Tests	Test Method	Min.	Max.
Emulsion			
Viscosity , SF, 140° F (60° C), s (Project-site Acceptance/Rejection Limits)	AASHTO T 59	100	400
Settlement (a) 5 days, percent	AASHTO T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	AASHTO T 59		
Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosuccinate, percent	AASHTO T 59	40	
Particle Charge Test	AASHTO T 59	Positive	
Sieve Test, percent	AASHTO T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		68	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5 s, dmm	AASHTO T 49	80	150
Ductility, 39.2° F (4° C), 5 cm/min, cm	AASHTO T 51	35	
Toughness, lb-in	ASTM D 5801	75	
Tenacity, lb-in	ASTM D 5801	50	
Solubility in trichloroethylene, percent	AASHTO T 44	97.5	
(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than a five-day time unless the purchaser requires the test. (b) The 24-hour (1-day) storage stability test may be used instead of the five day settlement test. (c) The demulsibility test is made within 30 days from date of shipment. (d) Distillation is determined by AASHTO T 59 with modifications to include a $350 \pm 5^\circ \text{F}$ ($177 \pm 3^\circ \text{C}$) maximum temperature to be held for 15 minutes. Modify the asphalt cement before emulsification.			

Table 11

Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)			
Tests	Test Method	Min.	Max.
Emulsion			
Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)	AASHTO T 59	140	400
Settlement (a) 5 days, percent	AASHTO T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	AASHTO T 59		1
Demulsibility (c) 35 ml, 0.8% sodium Dioctyl Sulfosuccinate, percent	AASHTO T 59	40	
Particle Charge Test	AASHTO T 59	Positive	
Sieve Test, percent	AASHTO T 59		0.3
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		65	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5 s, dmm	AASHTO T 49	40	200
Torsional Recovery (e)		18	
(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than a five-day time unless the purchaser requires the test. (b) May use the 24-hour (1-day) storage stability test instead of the five-day settlement test. (c) Make the demulsibility test within 30 days from date of shipment. (d) Determine distillation by AASHTO T 59, with modifications to include a $350 \pm 5^\circ\text{F}$ ($177 \pm 3^\circ\text{C}$) maximum temperature to be held for 15 minutes. (e) CA 332 (California Test Method)			
Co-mill latex and asphalt during emulsification			

Table 12

Cationic Medium Setting Emulsified Asphalt (CMS-2S)		
Tests	Test Method	Specification
Emulsion		
Viscosity, SF, 122° F (50° C), s	AASHTO T 59	50 - 450
Percent residue	AASHTO T 59	60 min
Storage Stability Test, 1d, 24h, percent	AASHTO T 59	1 max
Sieve, percent	AASHTO T 59	0.10 max
Particle charge	AASHTO T 59	Positive
Oil Distillate, percent by volume of emulsion	AASHTO T 59	5-15
Residue		
Penetration, 77° F (25° C), 100g, 5 sec, dmm	AASHTO T 59	100-250
Solubility, percent	AASHTO T 59	97.5 min.

Table 13

High Float Medium Setting Emulsified Asphalt (HFMS-2)			
Tests	Test Method	Min.	Max.
Emulsion			
Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)	AASHTO T 59	70	300
Storage Stability Test, 1d, 24 h, percent	AASHTO T 59		1.0
Sieve Test , percent	AASHTO T 59		0.1
Distillation			
Oil Distillate, by volume of emulsion, percent	AASHTO T 59	NA	NA
Residue, percent	AASHTO T 59	65	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100g, 5 s, dmm	AASHTO T 49	50	200
Float Test, 140° F (60° C), s	AASHTO T 50	1,200	
Solubility in Trichloroethylene, percent	AASHTO T 44	97.5	
Ductility, 77° F (25° C) 5cm/min, cm	AASHTO T 51	40	

Table 14

High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P) (a)			
Tests	Test method	Min.	Max.
Emulsion			
Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)	AASHTO T 59	100	450
Storage Stability Test, 1 d, 24 h, percent	AASHTO T 59		1.0
Sieve Test, percent	AASHTO T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	AASHTO T 59		7
Residue (b), percent	AASHTO T 59	65	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5 s, dmm	AASHTO T 49	70	300
Float Test, 140° F (60° C), s	AASHTO T 50	1,200	
Solubility in trichloroethylene, percent	AASHTO T 44	97.5	
Elastic Recovery, 77° F (25° C), percent	AASHTO T 301	50	
(a) Supply an HFMS-2P (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours. (b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5° F (177 ± 3° C) maximum temperature to be held for 15 minutes.			

Table 15

High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2SP) (a)			
Tests	Test method	Min.	Max.
Emulsion			
Viscosity, SF, 122° F (50° C), s (Project Site Acceptance/Rejection Limits)	AASHTO T 59	50	450
Storage Stability Test, 1 d, 24 h, percent	AASHTO T 59		1
Sieve Test, percent	AASHTO T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	AASHTO T 59		7
Residue (b), percent	AASHTO T 59	65	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5 s, dmm	AASHTO T 49	150	300
Float Test, 140°F (60°C), s	AASHTO T 50	1200	
Solubility in trichloroethylene, percent	AASHTO T 44	97.5	
Elongation Recovery(c), 77° F (25° C), percent	AASHTO T 301	50	
(a) Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours. (b) Determine the distillation by AASHTO T 59, with modifications to include a $350 \pm 5^\circ \text{F}$ ($177 \pm 3^\circ \text{C}$) maximum temperature to be held for 15 minutes. (c) Report only when penetration is greater than 300 dmm.			

Table 16

High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P) (a)			
Tests	Test method	Min.	Max.
Emulsion			
Viscosity, SF @ 122° F (50° C), s (Project Site Acceptance/Rejection Limits)	AASHTO T 59	50	450
Storage Stability Test (b) 1 d, 24 h, percent	AASHTO T 59		1
Demulsibility 0.02 N Ca Cl ₂ , percent	AASHTO T 59	40	
Sieve Test, percent	AASHTO T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	AASHTO T 59		3
Residue (b), percent	AASHTO T 59	65	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5 s, dmm	AASHTO T 49	70	150
Float Test, 140° F (60° C), s	AASHTO T 50	1,200	
Solubility in trichloroethylene, percent	AASHTO T 44	97.5	
Elastic Recovery, 77° F (25° C), percent	AASHTO T 301	58	
(a) Supply an HFMS-2SP (anionic, polymerized, high-float) as an emulsified blend of polymerized asphalt cement, water, and emulsifiers. Polymerize the asphalt cement with at least 3.0% polymer by weight of the asphalt cement before emulsification. The emulsion must be smooth and homogeneous throughout with no white, milky separation, pumpable, and suitable for application through a distributor after standing undisturbed for at least 24 hours.			
(b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5°F (177±3°C) maximum temperature to be held for 15 minutes.			

Table 17

Cationic Rapid Setting Emulsified Asphalt (CRS-2A,B)			
Tests	Test Method	Min	Max
Emulsion			
Viscosity, SF, 122° F (50° C), s (Project Site Rejection/Acceptance Limits)	AASHTO T 59	140	400
Storage stability test, 24 h, percent	AASHTO T 59		1
Demulsibility, 35 mL 0.8 percent Sodium Dioctyl Sulfosuccinate, percent	AASHTO T 59	40	
Particle charge test	AASHTO T 59	Positive	
Sieve test, percent	AASHTO T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent	AASHTO T 59		0
Residue, percent	AASHTO T 59	65	
Use PG58-22 and PG64-22 as base asphalt cement for CRS-2A, B, respectively. Specification for high temperature performance – original and RTFO G*/sinδ within 3° C of grade.			

Table 18

Emulsified Asphalt Pavement Rejuvenating Agent Concentrate Type A		
Property	Test Method	Limits
Viscosity, SF, 77° F (25° C), s	AASHTO T 59	15 Min 40 Max
Residue , percent W (a)	AASHTO T 59	60 Min. 65 Max.
Miscibility Test (b)	AASHTO T 59	No Coagulation
Sieve Test, percent W (c)	AASHTO T 59	0.20 Max.
5-day Settlement, percent W	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
Light Transmittance , %	UDOT MOI 8-973	30 Max.
Cement Mixing	AASHTO T 59	2 Max.
Residue from Distillation (a)		
Viscosity, 140° F (60° C), mm ² /s	ASTM D 4402	150 - 300
Flash Point, COC, ° F (° C)	AASHTO T 48	385 Min.
Asphaltenes, percent W	ASTM D 2006	0.4 Min. 0.75 Max.
Maltene Distribution Ratio (PC + A ₁)/(S + A ₂) (d)	ASTM D 2006	0.3 Min. 0.6 Max
Saturated Hydrocarbons, S (d)	ASTM D 2006	21 Min. 28 Max.
PC/S Ratio (d)	ASTM D 2006	1.5 Min.
(a) AASHTO T 59, Evaporation Test, modified as follows: Heat a 50 gram sample to 300°F until foaming ceases, then cool immediately and calculate results. (b) AASHTO T 59, modified as follows: Use a 0.02 Normal Calcium Chloride solution in place of distilled water. (c) AASHTO T 59, modified as follows: Use distilled water in place of a two percent sodium oleate solution. (d) Chemical composition by ASTM Method D-2006-70: PC= Polar Compounds, A ₁ = First Acidaffins A ₂ = Second Acidaffins, S = Saturated Hydrocarbons		

Table 19

Emulsified Asphalt Pavement Rejuvenating Agent Concentrate Type B		
Tests	Test Method	Limits
Viscosity, SF, 77° F (25° C), s	AASHTO T 59	25 - 150
Residue, percent W	AASHTO T 59 (mod) (a)	62 Min.
Sieve Test, percent W	AASHTO T 59	0.10 Max.
5-day Settlement	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
Pumping Stability (b)		Pass
Residue from Distillation (a)		
Viscosity @ 140° F (60° C), mm ² /s	AASHTO T 201	2,500 - 7,500
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC	AASHTO T 48	204° C, Min.
Asphaltenes, percent W	ASTM D 2007	15 Max.
Saturates, percent W	ASTM D 2007	30 Max.
Aromatics, percent W	ASTM D 2007	25 Min.
Polar Compounds, percent W	ASTM D 2007	25 Min.
(a) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5° F (149 ± 3° C) maximum temperature to be held for 15 minutes. (b) Test pumping stability by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77° F (25° C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.		
Type B – an emulsified blend of lube oil or lube oil extract and petroleum asphalt.		

Table 20

Emulsified Asphalt Pavement Rejuvenating Agent Concentrate Type B Modified		
Property	Test Method	Limits
Viscosity, SF, 77° F (25° C), s	AASHTO T 59	50 - 200
Residue(a), percent W	AASHTO T 59	62 Min.
Sieve Test, percent W	AASHTO T 59	0.20 Max.
5-day Settlement, percent W	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
Pumping Stability (b)		Pass
Residue from Distillation (a)		
Viscosity (c) 275° F (135° C), cP	ASTM D 4402	150 - 300
Penetration, 77° F (25° C), dmm	AASHTO T 49	180 Min.
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC, ° F (° C)	AASHTO T 48	400(204) Min.
Asphaltenes, percent W	ASTM D 2007	20 - 40
Saturates, percent % W	ASTM D 2007	20 Max.
Polar Compounds, percent W	ASTM D 2007	25 Min.
Aromatics, percent W	ASTM D 2007	20 Min.
PC/S Ratio	ASTM D 2007	1.5 Min.
(a) Determine the distillation by AASHTO T 59 with modifications to include a 300±5°F (149 ± 3° C) maximum temperature to be held for 15 minutes. (b) Pumping stability is tested by pumping 475 ml of Type B diluted 1 part concentrate to 1 part water, at 77° F (25° C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material. (c) Brookfield Thermocel Apparatus-LV model. ≥ 50 rpm with a #21 spindle, 7.1 g residue, at > 10 torque		
As required by the Asphalt Emulsion Quality Management Plan 508, UDOT Minimum Sampling and Testing Requirements, the supplier certifies that the base stock contains at least 15% by weight of Gilsonite Ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.		

Table 21

Emulsified Asphalt Pavement Rejuvenating Agent Concentrate Type C		
Property	Test Method	Limits
Viscosity, SF, 77° F (25° C), s	AASHTO T 59	10 - 100
Residue (a), percent W (Type C supplied ready to use 1:1 or 2:1.	AASHTO T 59	30 Min. 1:1 40 Min. 2:1
Sieve Test, percent W (b)		0.10 Max.
5-day Settlement, percent W	AASHTO T 59	5.0 Max.
Particle Charge	AASHTO T 59	Positive
pH (May be used if particle charge test is inconclusive)		2.0 - 7.0
Pumping Stability (c)		Pass
Tests of Residue from Distillation (a)		
Viscosity, 275° F (135° C), mm ² /s	AASHTO T 201	475 - 1,500
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	97.5 Min.
RTFO mass loss, percent W	AASHTO T 240	2.5 Max.
Specific Gravity	AASHTO T 228	0.98 Min.
Flash Point, COC	AASHTO T 48	232° C, Min.
Asphaltenes, percent W	ASTM D 2007	25 Min., 45 Max.
Saturates, percent W	ASTM D 2007	10 Max.
Polar Compounds, percent W	ASTM D 2007	30 Min.
Aromatics, percent W	ASTM D 2007	15 Min.
(a) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5° F (149 ± 3° C) maximum temperature to be held for 15 minutes. (b) Test method identical to AASHTO T 59 except that distilled water is used in place of 2% sodium oleate solution. (c) Test pumping stability by pumping 475 ml of Type diluted 1 part concentrate to 1 part water, at 77° F (25° C) through a ¼ inch gear pump operating at 1750 rpm for 10 minutes with no significant separation or coagulation in pumped material.		
As required by the Asphalt Emulsion Quality Management Plan Section 508 , UDOT Minimum Sampling and Testing Requirements,, the supplier certifies that the base stock contains at least 10% by weight of Gilsonite ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.		

Table 22

Emulsified Asphalt Pavement Rejuvenating Agent Concentrate Type D		
Property	Test Method	Limits
Viscosity, SF, 77° F (25° C), s	AASHTO T 59	30 - 90
Residue, (b) percent W	AASHTO T 59	65
Sieve Test, percent W	AASHTO T 59	0.10 Max.
pH		2.0 - 5.0
Residue from Distillation (b)		
Viscosity, 140° F (60° C), cm ² /s	AASHTO T 201	300 - 1200
Viscosity, 275° F (135° C), mm ² /s	AASHTO T 201	300 Min.
Modified Torsional Recovery (a) percent	CA 332 (Mod)	40 Min.
Toughness, 77° F (25° C), in-lb	ASTM D 5801	8 Min.
Tenacity, 77° F (25° C), in-lb	ASTM D 5801	5.3 Min.
Asphaltenes, percent W	ASTM D 2007	16 Max.
Saturates, percent W	ASTM D 2007	20 Max.
(a) Torsional recovery measurement to include first 30 seconds. (b) Determine the distillation by AASHTO T 59 with modifications to include a 300 ± 5° F (149 ± 3° C) maximum temperature to be held for 15 minutes.		

2.3 HOT-POUR CRACK SEALANT FOR ASPHALT PAVEMENT

- A. Combine a homogenous blend of materials to produce a sealant according to properties and tests in Table 23.
- B. Packaging and Marking – Supply sealant pre-blended, pre-reacted, and pre-packaged in lined boxes weighing no more than 30 lb.
 1. Use a dissolvable lining that will completely melt and become part of the sealant upon subsequent re-melting.
 2. Deliver the sealant in the manufacturer's original sealed container.
 - a. Clearly mark each container with the manufacturer's name, trade name of sealant, batch or lot number, and recommended safe heating and application temperatures.

Table 23

Hot-Pour Asphalt Pavement Crack Sealant			
Application Properties			
Workability	Pour readily and penetrate 0.25 inch and wider cracks for the entire application temperature range recommended by the manufacturer.		
Curing	No tracking caused by normal traffic after 45 minutes from application.		
Asphalt Compatibility ASTM D 5329, Section 14.	No failure in adhesion. No formation of an oily ooze at the interface between the sealant and the asphalt pavement or softening or other harmful effects on the asphalt pavement.		
Material Handling	Follow the manufacturer's safe heating and application temperatures.		
Test Method	Property	Minimum	Maximum
AASHTO T 51	Ductility, modified, 1cm/min, 39.2° F (4° C), cm	30	
UDOT method 967	Cold Temperature Flexibility	no cracks	
AASHTO T 300 (a)	Force-Ductility, lb force		4
ASTM D 5329	Flow 140°F (60° C), 5 hrs 75° angle, mm		3
AASHTO M 282 (b)	Tensile-Adhesion, modified	300%	
AASHTO T 228	Specific Gravity, 60° F (15.6° C)		1.140
ASTM D 5329	Cone Penetration, 77° F (25° C), 150 g, 5 sec., dmm		90
ASTM D 5329	Resilience, 77° F (25° C), 20 sec., percent	30	
ASTM D 4402	Viscosity, 380°F (193.3°C), SC4-27 spindle, 20 rpm, Cp		2,500
ASTM D 5329	Bond, Non-Immersed as specified in AASHTO M 282		Pass
(a)	Maximum of 4 lb force during the specified elongation of 30 cm @ 1 cm/min, 39.2° F (4° C).		
(b)	Delete Bond, Non-Immersed modification in AASHTO M 282. Perform tensile-adhesion test according to ASTM D 5329.		

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 02746

HYDRATED LIME

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and procedures for incorporating hydrated lime into all asphalt mixes.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. AASHTO M 303: Lime for Asphalt Mixtures
- B. ASTM C 110: Physical Testing of Quicklime, Hydrated Lime, and Limestone
- C. ASTM C 1097: Hydrated Lime for Use in Asphalt Cement or Bituminous Paving Mixtures
- D. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete
- E. UDOT Materials Manual of Instruction
- F. UDOT Quality Management Plans

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 QUALITY ASSURANCE

- A. Use a supplier of Hydrated Lime that is pre-qualified through UDOT Quality Management Plan 510.
- B. Comply with UDOT Quality Management Plan 514, Hot-Mix Asphalt.

PART 2 PRODUCTS

2.1 HYDRATED LIME

- A. Hydrated Lime – Refer to AASHTO M 303, Type I.
 - 1. Refer to ASTM C 1097, Physical Requirements.
 - 2. Use test method ASTM C 110.

2.2 WATER

- A. Use potable water or water according to ASTM C 1602.

PART 3 EXECUTION

3.1 APPLICATION

- A. Add hydrated lime to all asphalt pavement mixes.
 - 1. Add lime as determined in the approved mix design.
 - 2. Base the amount of hydrated lime used on the dry weight of the virgin aggregate.
 - 3. Use either Method A or B, unless Method B is specified.
 - 4. Use Method A only when the mix is produced by a Certified Hot-Mix Asphalt Supplier. Refer to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.

- B. Method A – Dynamic Feed Lime Slurry
 - 1. Lime Slurry –At least three parts water to one part lime by weight.
 - a. Adjust the amount of added water to meet the 3:1 lime slurry to account for the moisture in the stockpile.
 - b. Use lime slurry with a minimum of one part water by weight of lime.
 - 2. Add at least 1 percent lime by weight of the virgin aggregate.
 - 3. Deliver lime slurry to the twin shaft pugmill for mixing with aggregate.
 - a. Use a virgin aggregate/lime mixture that contains at least 3 percent water by weight of the virgin aggregate after the pugmill.
 - 4. Adjust quantity (percent) of lime as necessary, based on results of Hamburg Wheel Tracker test.
 - 5. Verify that Lime Slurry equipment is operating at all times.
 - a. The Engineer may require Method B, marination of the aggregate/hydrated lime mixture in the stockpile if the HMA is supplied without hydrated lime slurry treatment.

- C. Method B – Lime and Aggregate Stockpile Marination
1. Method B is an option for a Certified Hot Mix Asphalt Supplier.
 2. Method B is required for all Hot-Mix Asphalt Suppliers that are not certified according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.
 - a. The Engineer will inspect the marination process when the HMA supplier is not certified at the time of production.
 3. The Department applies a deduction for mix produced by a non-certified supplier to cover the cost of the inspection.
 - a. The deduction is according to the UDOT Quality Management Plan 514 Hot-Mix Asphalt.
 4. Provide sufficient free moisture to thoroughly wet the aggregate and activate the lime before introducing hydrated lime.
 - a. The aggregate/lime mixture will contain at least 3 percent water by weight of the virgin aggregate.
 5. Add at least 1½ percent lime by weight of the virgin aggregate.
 6. Thoroughly mix wet aggregate/lime mixture in a twin shaft pugmill.
 7. Marinate the aggregate/lime mixture in the stockpile for at least 48 hours.
 8. Adjust quantity (percent) of lime as necessary, based on results of Hamburg Wheel Tracker test, UDOT Materials Manual of Instruction 990.
 9. Use the wet cured aggregate within 60 days except as otherwise provided in the UDOT Quality Management Plan 514 Hot-Mix Asphalt.
- D. Mixing Methods A and B – Provide a horizontal twin shaft pugmill.
1. Adjust mixing paddles in the pugmill so that the aggregate being discharged is completely coated by the lime slurry.
 2. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.

3.2 QUALITY CONTROL

- A. Tolerance Controls
1. Tolerance lime weight vessel static calibration ± 1.5 percent
 2. Dynamic delivery calibration ± 1.5 percent
 3. Inlet flow meter ± 2 percent
 4. Discharge flow meter ± 1.5 percent

END OF SECTION

SECTION 02748

PRIME COAT/TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for applying prime and tack coat.
- B. Blotter materials and procedures for absorbing excess asphalt as required.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02721: Untreated Base Course
- C. Section 02745: Asphalt Material

1.3 REFERENCES

- A. AASHTO M 208: Cationic Emulsified Asphalts
- B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- C. AASHTO T 201: Kinematic Viscosity of Asphalts

1.4 DEFINITIONS

- A. Cutback Asphalt – Asphalt product using a solvent to reduce viscosity. MC-70 and MC-250 as used in this Section, article 2.1 refer to Medium Cure (MC). The number following “MC” describes the viscosity of the product during application, higher numbers indicating higher viscosity (thicker). Do not dilute these products. These products meet the requirements of Section 02745.

- B. Emulsified Asphalt – A group of asphalt products using water and soap (emulsifier) to reduce viscosity. These products consist of approximately 60 percent asphalt and 40 percent emulsifier.
1. Refer to Section 02745 for the exact ratio as well as other properties.
 - a. The product is called a “straight” or a “concentrate” emulsion in this condition.
 2. CSS 1h and CQS 1h as used in this Section, Article 2.1 refer to Cationic Slow Set and Quick Set respectively.
 - a. The 1h designation refers to the residual binder grade as “hard” or an AC-20.
 3. A diluted product may be used to better control distribution when the residual application rate is small (0.03 gal/yd²).
 - a. The product will be referred to as a 1:1 or 2:1 dilute meaning 2 parts emulsion to 1 part water for the latter case when this is done.
- C. Prime coat – Liquid asphalt to a prepared subgrade or untreated base course.
- D. Tack coat – Emulsified asphalt to the existing surface or new pavement surface and intermediate lifts.

1.5 SUBMITTALS

- A. Material invoice or bill of lading.

PART 2 PRODUCTS

2.1 PRIME COAT

- A. MC-70 or MC-250. Refer to Section 02745.
- B. Blotter material – Granular materials, Table 1 when tested according to AASHTO T 27.

Table 1

Granular Materials	
Sieve Size	Percent Passing
No. 4	90 to 100
No. 10	25 to 80
No. 200	0 to 15

2.2 TACK COAT

- A. CQS-1h or CSS-1h emulsified asphalt. Refer to AASHTO M 208 and Section 02745.
 - 1. Select emulsion according to the time constraints required for Maintenance of Traffic (MOT) and the ability to fully cure before allowing traffic on the roadway.
 - a. Residual asphalt content to be approximately 60 percent.
 - 1) Dilute at terminal only.
 - 2) Do not change dilution before obtaining approval from the Engineer.
- B. Tack coat for paving fabrics is a PG 58-22 or PG 64-22.
- C. Do not use an emulsion or cutback in paving fabric placement.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. Prime Coat
 - 1. Shape the surface to the required grade and section.
 - 2. Keep the surface free from ruts, corrugations, or other irregularities.
 - 3. Compact the surface according to Section 02721.
- B. Tack Coat
 - 1. Clean the surface of all materials that prevent the tack coat from bonding to the existing surface such as mud, dirt, leaves, and water.
 - 2. Cover all tacked surface areas with surfacing materials the same day the tack coat is applied.

3.2 APPLICATION

- A. Apply at the following rates:
 - 1. Prime Coat – 0.5 gal/yd²
 - 2. Tack Coat – Refer to Table 2.

Table 2

Application Rate (gal/yd²)				
Existing Pavement Condition	Residual	Undiluted	1: 1 Dilute	2:1 Dilute
New HMA	0.03	0.05	0.10	0.08
Oxidized HMA	0.05	0.09	0.18	0.13
Milled HMA	0.07	0.12	0.24	0.18
Milled PCCP	0.07	0.12	0.24	0.18
PCCP	0.05	0.09	0.18	0.13

Residual – Asphalt binder content needed on the pavement.

Undiluted and 1:1 and 2:1 Dilute. Adjust the application rate if emulsion is not 60 percent residual asphalt.

3. Obtain approval for the quantities, rate of application, temperatures, and areas to be treated before any application. Application rates may vary according to field conditions.
- B. Do not apply prime coat or tack coat:
 1. On a wet surface or where surface conditions prevent proper adhesion.
 2. When the surface temperature is below 50 degrees F.
 3. When weather conditions prevent proper adhesion.
 - C. Protect all structures including items such as guardrails and guide posts from being spattered or marred.
 - D. Use a pressure distributor to apply the asphalt in a uniform, continuous spread.
 - E. Keep the viscosity between 50 and 100 centistokes. Refer to AASHTO T 201.
 - F. Immediately apply another application to under primed surface.
 - G. Apply tack coat between all lifts of Hot Mix Asphalt and to all surfaces, including vertical that will come in contact with Hot Mix Asphalt.
 1. Apply prime coat to protect the grade from damage.
 - H. Spread blotter material if the prime coat does not penetrate.
 1. Use the quantities required to absorb the excess asphalt.
 - I. Allow prime or tack coat to fully cure before allowing traffic on paving.

3.3 TRAFFIC CONTROL

- A. Refer to Section 01554.
- B. Maintain the prime coat/tack coat until the next course is placed.
- C. Keep all traffic off the prime coat until it has cured and dried.

END OF SECTION

SECTION 02751

PARTIAL DEPTH REPAIR FOR CONCRETE PAVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Remove spalled or delaminated concrete in the upper one third to one half of the pavement.
 - 1. Clean, maintain, and prepare joints.
 - 2. Furnish, place, and cure patch material.

1.2 RELATED SECTIONS

- A. Section 02752: Portland Cement Concrete Pavement
- B. Section 03055: Portland Cement Concrete
- C. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 235: Epoxy Resin Adhesives.
- B. AASHTO M 324: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 PARTIAL DEPTH CONCRETE PAVEMENT REPAIR MATERIAL

- A. Patching Material
 - 1. Use Portland Cement Concrete. Refer to Section 03055.

2. Other patching products are subject to Engineer's approval and used according to manufacturer's recommendation.
 - a. Have manufacturer's representative on site for first day of proprietary material placement.

2.2 CONCRETE CURING COMPOUND

- A. Refer to Section 03390.

2.3 HOT APPLIED JOINT FILLER

- A. Refer to AASHTO M 324.

PART 3 EXECUTION

3.1 REMOVE SPALLED OR DELAMINATED CONCRETE

- A. Establish rectangular or circular sections, extending at least 2 inches beyond a spalled area or 6 inches beyond the failed area determined by sounding.
 1. Provide vertical perimeter saw cuts of 2 inch minimum depth. Maintain uniform depth of the repair area.
- B. Complete removal with concrete saws and 30 lb class or smaller hand jackhammers.
- C. The Engineer will remark the area that is discovered to be spalled or delaminated during the initial removal of the damaged portion.
 1. Removal and repair of any such extended areas will be paid under the Contractor's unit bid price for Partial Depth Slab Repair.
- D. Repair any damage caused by the operation.

3.2 CLEAN ALL EXPOSED SURFACES

- A. Remove all loose particles, oil, dust, traces of asphalt concrete, or other contaminants.
 1. Use sandblasting or waterblasting with at least 2,000 psi.
- B. Remove all cleaning grit before placement.
- C. Sandblast clean or remove partially exposed reinforcing steel before placing the patch material.

3.3 PREPARE EXISTING JOINTS FOR PLACEMENT

- A. Maintain Existing Joints – Maintain a width equal to the opening in all working joints and cracks within or adjacent to the patch by inserting a removable material such as cardboard, polyfoam, or fiberboard before placing the mix.
 - 1. Use a material of uniform size and thickness.
- B. Place the joint forming material 1 inch below and 3 inches laterally beyond the patch boundary.
 - 1. Do not widen the existing joint to provide for or facilitate placement of the removable joint material.

3.4 MATERIAL PLACEMENT

- A. Meet the following requirements for placing Portland Cement Concrete:
 - 1. Prepare the existing surface by applying a bonding agent of cementitious grout or epoxy designed for bonding concrete products.
 - a. Prepare grout by combining sand and Portland Cement in a 1:1 ratio by volume and enough water to produce a creamy consistency.
 - 1) Apply with a brush to bottom and sides of repair area.
 - b. Use an appropriate material according to AASHTO M 235 when using epoxy bonding agent.
 - 1) Select Type and Class for the application.
 - 2) Apply epoxy according to manufacturer's recommendations.
 - 2. Place patching material before bonding agent dries.
- B. Meet the following requirements for placing proprietary patching materials:
 - 1. Do not begin placement before having a manufacturer representative on site. Manufacturer's representative will address these requirements:
 - a. On site mixing permissibility and constraints
 - b. Surface preparation of the repair area and appropriate bonding agent
 - c. Consolidation requirements
 - d. Pot life of mix
 - e. Environmental conditions and limitations

3.5 FINISH

- A. Finish the patched surface to within $\frac{1}{8}$ inch of the existing pavement.

3.6 CURE AND PROTECT

- A. Cure the patched surface immediately after finishing operations according to Section 03390 with the following change:
 - 1. Uniformly spray the surface at a rate of 50 ft²/gal.
- B. Do not open to traffic until patching material has achieved required strength.
- C. Protect all placements with an approved traffic control device.
- D. Remove and replace any patches that are rejected before substantial completion due to the following:
 - 1. Failures due to cracking including any visible crack, shrinkage including breaking of bond between patch and pavement, or pop-outs including pieces of pavement broken loose from surface greater than ½ inch diameter.
 - 2. Unsatisfactory or improper workmanship by the Contractor, including patches with surface profiles that vary from the existing roadway profile by more than ⅛ inch.
 - a. Patches with a profile higher than ⅛ inch from the existing roadway profile may be ground to meet existing profile instead of removal and replacement.
 - 3. Failures due to damage by the operation or public traffic.
- E. Fill overcuts flush to the pavement surface with an approved repair epoxy.
- F. Remove joint forming material and fill all affected joints with hot pour material. Refer to AASHTO M 324.

3.7 CLEAN PAVEMENT

- A. Sweep roadway and shoulders of all debris before opening to traffic. Prevent damage to the patches from cleaning equipment.

3.8 LIMITATIONS

- A. Refer to Section 02752.

END OF SECTION

SECTION 02752

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Portland Cement Concrete Pavement.

1.2 RELATED SECTIONS

- A. Section 00555: Prosecution and Progress
- B. Section 02701: Pavement Smoothness
- C. Section 02742S: Project Specific Surfacing Requirements
- D. Section 03055: Portland Cement Concrete
- E. Section 03152: Concrete Joint Control

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. AASHTO M 157: Ready-Mixed Concrete
- C. AASHTO M 284: Epoxy Coated Reinforcing Bars – Materials and Coating Requirements
- D. AASHTO T 22: Compressive Strength of Cylindrical Concrete Specimens
- E. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- F. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by use of the Sand Equivalent Test
- G. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests
- H. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete

- I. American Concrete Institute (ACI) Standards
- J. ASTM C 309-11: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- K. UDOT Minimum Sampling and Testing Requirements
- L. UDOT Quality Management Plan 506

1.4 DEFINITIONS

- A. Panel – Area of pavement within a traffic lane or shoulder bound by two transverse joints.

1.5 SUBMITTALS

- A. All submittals required in Section 03055.
 - 1. Mix design trial batch information to include flexural test results and Sand Equivalent.
- B. Certified scale axle weights for each haul unit for yardage to be hauled when requested by the Engineer.
- C. A written plan for approval at least 14 calendar days before concrete placement showing:
 - 1. Production methods
 - 2. Handling and placing
 - 3. Protection and curing including hot or cold weather plan or both
 - 4. Cylinder storage device. Refer to this Section, Article 2.6.
 - a. Procedures explaining operation, monitoring, and maintenance of the device.
- D. Written verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.
- E. Joint layout plan for approval at least 14 calendar days before concrete placement.
- F. Deliver individual batch tickets, with each load of concrete, to the Engineer at the job site.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. Point of acceptance for air content is the in-place pavement.
 - 1. Sampling and testing will be performed at the point of placement with necessary adjustments applied based on correlation testing. The Department will:
 - a. Perform air test on concrete placed in front of the paver and again from the same load in the finished pavement. Record any change in air content.
 - b. Adjust acceptance limits for air content according to results of correlation testing to provide final in-place air content that meets the requirements specified in Section 03055.
 - c. Perform at least one correlation test for each day of paving operations.
 - 2. The Engineer will mark for later removal any areas determined to be reject material.
 - a. Coordinate the timing for removal of reject material with the Engineer
- C. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the pay item.
- D. Thickness
 - 1. Contractor obtains cores for thickness according to AASHTO T 24 after all grinding for smoothness is completed.
 - a. The Engineer marks core location.
 - b. One thickness core per 12,000 ft²
 - 2. The Engineer determines the acceptability and pay factors for deficient thickness areas using Table 1.

Table 1

Price Reductions for Deficient Thickness	
Deficient Thickness (inches)	Pay Factor
0 to $\frac{1}{8}$	1.00
$\frac{1}{8}$ to $\frac{1}{4}$	0.90
$\frac{1}{4}$ to $\frac{1}{2}$	0.75
$\frac{1}{2}$ to $\frac{3}{4}$	0.60
$>\frac{3}{4}$	Reject

- a. The Engineer may accept pavement deficient by more than $\frac{3}{4}$ inch at 50 percent pay or require removal and replacement.
- b. Take two additional cores for any deficient core (one on each side) where the thickness varies by $\frac{1}{8}$ inch. Locate the additional core midway between the deficient core and each of the adjacent cores.
- c. The Engineer graphs the deficient areas by plotting new cores and the original cores to define deficient areas, assuming the following:
 - 1) The graph represents the thickness of the pavement.
 - 2) The thickness varies linearly along the pavement length from core depth to core depth.
 - 3) The pavement is a constant depth in the transverse direction.
3. Acceptance for thickness may be determined through alternate methods from coring with approval.

E. Compressive Strength Acceptance

1. Compressive strength is determined by the average of three cylinders, which constitutes one strength test. Refer to Section 03055.
2. Hand-placement areas will be considered separately. Refer to Section 03055 testing frequency.
3. Retesting –
 - a. The Engineer notifies the Contractor, within three calendar days of determining the 28-day compressive strength, if any test is below specifications.
 - 1). The Contractor has the option to contest the compressive strength results.
 - 2) The Contractor obtains one set of three cores at the approximate location where the contested cylinders were obtained as determined by the Engineer if contesting the results. Refer to AASHTO T 22 and AASHTO T 24.
 - 3). An independent third party testing agency conducts the retesting.
 - (a) Testing laboratories must be a Department qualified concrete lab.
 - (b) Use UDOT TTQP technician qualified in Concrete and Concrete Strength Testing .
 - 4) Compressive strength is the average of the results of the three cores and payment will be based on Table 1 in Section 03055.

- 5) Payment will be based on the lowest compressive strength of the individual cores, as per Table 1 in Section 03055, if the compressive strength of any one of the cores differs by 10 percent or more from the average of the three,
 - 6) Do not apply a correction factor to compressive strength results.
 - 7) Results of the core testing replaces the results of the cylinder test results and are binding on the Contractor and the Department.
 - 8) Retesting must be completed within 40 calendar days after placement.
- b. Dispute of the original cylinder compressive strength test results will not be considered when the requirements of providing and maintaining a cylinder storage device are not fully met, refer this Section article 2.6.

F. Smoothness

1. Evaluate according to Section 02701.

G. Quantity adjustment when overlaying existing pavement surfaces not constructed with the current project.

1. Adjust quantity when accepted batched volume overruns or under runs neat-line volume.
 - a. The Engineer and Contractor determine batched volume at time of placement.
 - b. Batched volume is the total batched material adjusted to design yield minus rejected or wasted material.
2. Adjust quantity before any price adjustment for non-specification material.
3. Determine overrun/underrun quantity by the following formula:

$$QA = 0.5 \left(\frac{V_a - V_n}{V_n} \right) Q_m$$

QA	=	Adjusted quantity in yd^2
V_a	=	Batched Volume
V_n	=	Neat-line Volume
Q_m	=	Measured quantity in yd^2

PART 2 PRODUCTS

2.1 CONCRETE

- A. Use Class AA(P) concrete. Refer to Section 03055.
 - 1. Meet a 28 day flexural strength of 650 psi verified through trial batch.
 - 2. Meet a minimum Sand Equivalent of 75. Refer AASHTO T 176 (pre-wet method).

2.2 CONCRETE CURING COMPOUND

- A. Refer to ASTM C 309-11, Type 2, Class A.

2.3 JOINT SEALERS

- A. Use hot poured joint sealant meeting Section 03152.

2.4 REINFORCING STEEL

- A. Tie Bars
 - 1. Refer to AASHTO M 31, Grade 60 or higher, deformed reinforcing steel.
 - 2. Use epoxy coated unless otherwise specified.
- B. Dowel Bars
 - 1. Refer to AASHTO M 31, Grade 60 or higher, smooth steel rod.
 - 2. Use epoxy coated unless otherwise specified.
 - 3. Use a bond breaking compound approved by the Engineer.
- C. Provide basket assemblies for dowel bars in concrete pavement that meet the following requirements:
 - 1. Use a U-shape leg for the assembly frame.
 - 2. Use a minimum 0.306 inch diameter wire.
- D. Epoxy Coating
 - 1. Refer to AASHTO M 284.
 - 2. Maintain epoxy coating thickness between 8 and 12 mils.
 - 3. Repair any damage to the coating according to manufacturer's recommendations.

2.5 BATCH PLANT

- A. Meet the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

2.6 CYLINDER STORAGE DEVICE

- A. Use a device that maintains a temperature of 60 degrees F to 80 degrees F and is equipped with an automatic 24 hour temperature recorder, accurate within 2 degrees and with a permanent recording feature.
 - 1. A 24 hour test run may be required.
- B. Use device or devices with the capacity to accommodate the required test cylinders for at least two day's operation.
 - 1. Cease concrete operation when the storage capacity is reached.
- C. Make the storage devices available on the job site at least 48 hours before placement.

2.7 VEHICLES FOR HAULING

- A. End dump trucks with watertight beds and end gates and rounded corners.
- B. Agitator trucks with open tops.
- C. Transit mixers that conform to AASHTO M 157.
- D. Do not use bottom or belly dump units.

2.8 SLIP FORM PAVER

- A. Self-propelled machine with no fluid leaks equipped with automatic line and grade control capability.
- B. Capabilities
 - 1. Spreading the dumped concrete uniformly across the grade by an auger or a traveling strike-off device.
 - 2. Vibrating, tamping, striking-off, and shaping the concrete to the desired line grade and thickness in one continuous pass.
- C. Vibrator Minimum Requirements
 - 1. Eccentric Diameter $1\frac{7}{8}$ inch
 - 2. Frequency 7,000 to 9,000 vibrations per minute
 - 3. Spacing 18 inch maximum, mounted longitudinally

- D. Mount vibrators to provide adequate concrete consolidation.
 - 1. Do not interfere with dowel bar basket assemblies.
- E. Use trailing forms long enough to leave a smooth, straight, vertical edge.

2.9 CURING APPLICATION EQUIPMENT

- A. Use curing compound application machine with a fully atomizing type power spray and a wind protection hood.

PART 3 EXECUTION

3.1 LINE AND GRADE CONTROL

- A. Use a system that limits deviations in the pavement surface to $\frac{1}{8}$ inch in 10 feet and deviations in the vertical edge of the pavement to $\frac{1}{4}$ inch and maintains specified pavement thickness.
- B. Slip Form Paving
 - 1. Establish the necessary stakes for line and grade control over existing surfaces and provide the elevation control benchmarks.
 - 2. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades.
- C. Formed Paving
 - 1. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge.
 - 2. Tightly join form sections by an interlocking joint free of vertical and horizontal movement.
 - 3. Stop paving operations if the side forms do not meet or hold line and grade.
- D. Profile grind existing adjacent pavement before concrete placement.
 - 1. Profile grinding of existing pavement is measured and paid separately, or as extra work.

3.2 BATCH AND MIX

- A. Refer to AASHTO M 157.
- B. Separate and stockpile in two sizes coarse aggregate sizes 2 inch to No. 4 sieve and $1\frac{1}{2}$ inch to No. 4 sieve with the separation being made on the 1 inch and $\frac{3}{4}$ inch respectively.

- C. Mixing – Conform to the standard and operate the drum at manufacturer's recommended speed.
 - 1. Conduct mixing efficiency tests at the start of concrete placement and evaluate as specified in AASHTO M 157, Annex A-1.
 - 2. Increase mixing time in 10-second increments if necessary until the mixer efficiency evaluation is passed.
 - a. Correct poor mixing efficiency.
 - 3. Do not allow buildup of cement or mortar on the mixer drums and blades.
 - 4. Mix for at least 30 seconds after the last addition of water or cement is made after initial batching.
- D. Maintain a minimum mixing time of 80 seconds at the manufacturer's recommended mixing speed after all materials are in the drum.
 - 1. Include actual mix time on each computerized batch ticket as a part of the information automatically recorded.
- E. Do not add water to the mix after acceptance testing.

3.3 PLACE CONCRETE

- A. Keep the base surface moistened 500 ft in front of the paver without allowing areas of standing water.
- B. Discharge and place the mixed concrete within the time frame listed below after introducing the mixing water to the cement and aggregates.
 - 1. Concrete not placed within the following time period may be rejected.
 - 2. The Engineer, in conjunction with the Region Materials Engineer, may approve alternate time periods based on concrete and ambient temperatures.
 - a. Non-agitating Haul Equipment 45 minutes
 - b. Agitating Haul Equipment 75 minutes
- C. Do not interfere with dowel basket assemblies if redistributing the concrete in front of the paver.
 - 1. Minimize redistributing the concrete in front of the paver.
 - 2. The Engineer may retest the concrete if redistribution occurs.
- D. Consolidate concrete using vibrators.
 - 1. Position vibrators on finishing equipment ahead of strike-off auger or final screed.

2. Vibrate, screed, and mechanically tamp the spread concrete.
 - a. Thoroughly vibrate adjacent to and along the faces of the forms.
 - 1) Stop vibrating and tamping elements when the forward movement of the paver stops.
 3. Monitor the operation of vibrators.
 - a. Check each vibrator at the beginning and ending of each day.
 - b. Repair or replace vibrators as necessary.
 - c. Stop paving operations immediately if any indication of malfunction occurs.
 - d. Resume operations only after repairing or replacing the vibrator.
 4. Use hand-operated vibrators on a regular pattern, not to exceed 12 inches in each direction, for hand placements.
- E. Conform to ACI 304R-00 for workmanship.
- F. Do not add water to the surface for finishing.
 1. Paving operations may be shut down and the concrete rejected if water is added.
 2. Use evaporation retarders only after obtaining written approval by the Engineer.
- G. Provide protection for existing surfaces when placing concrete in an adjoining longitudinal section (companion placement).
 1. Do not place concrete for companion placement before existing concrete has achieved at least a compressive strength of 2,500 psi, determined by Maturity Method, AASHTO T 325, or cast cylinders.
 2. Repair damage to existing pavement resulting from companion placement.

3.4 HANDLE AND PLACE REINFORCING STEEL

- A. Keep reinforcing steel clean, free from damage, and free from distortion.
- B. Place tie bars in the middle third of the slab.
 1. Refer to PV Series Standard Drawings.
 2. Place in the direction of paving and parallel to the slab surface.
 3. Place by using automatic bar inserters, bar supports, through forms, or drilled and epoxied after concrete has hardened.
 - a. Do not manually insert tie bars while concrete is still plastic if using a paver.

4. Maintain at least 6 inch clearance between tie bars and dowel bars.
 - a. Adjust tie bar spacing at the transverse joints to provide required clearance.
 - b. Do not adjust dowel bar locations.
- C. Place load transfer dowel bars in the middle third of the slab depth, parallel to the centerline and surface of the slab.
 1. Limit deviations from parallel to $\frac{1}{4}$ inch for the length of the dowel bar.

3.5 FINISH

- A. Finish the surface smooth and true to grade by machine float immediately after placing concrete.
 1. Finish at a rate equal to the progress of the paving operation.
- B. Shut down the mixing operation until the situation is resolved if preliminary finishing is delayed more than 30 minutes after initial screeding.
- C. Fill honeycomb areas in the vertical edge of the pavement with mortar.
- D. Texture the pavement by burlap drag unless the final texture includes artificial turf drag.
 1. Use at least three plies of wet burlap and drag parallel to the centerline without tearing.
 2. Complete the drag finish with one pass.
 3. Spray water directly on the final burlap drag only in the quantity necessary to keep the burlap wet.

3.6 PAVEMENT TEXTURE

- A. Longitudinal Tining
 1. Produce grooves of approximately $\frac{1}{8}$ inch wide by $\frac{1}{8}$ inch deep spaced $\frac{3}{4}$ inch apart and parallel to the longitudinal joint.
 2. Keep tining devices clean and free from encrusted mortar and debris to provide uniform groove dimensions.
 3. Time tining so that the grooves do not close up.
- B. Diamond Grinding
 1. Produce resultant surface in a parallel, corrugated type texture.
 - a. Allowable width of grooves is $\frac{1}{16}$ inch to $\frac{1}{4}$ inch.
 - b. Allowable distance between grooves is $\frac{1}{16}$ inch to $\frac{1}{4}$ inch.
 - c. Maximum allowable height of ridges is approximately $\frac{1}{16}$ inch.
 2. Maintain cross slope drainage.

- C. Transverse Tining
 - 1. Produce randomly spaced $\frac{1}{2}$ inch to $\frac{3}{4}$ inch transverse grooves approximately $\frac{1}{8}$ inch deep.
- D. Artificial Turf Drag
 - 1. Drag artificial turf along the pavement in the direction of paving.
 - 2. Use plastic turf that is wide enough to cover the entire pavement width and produce a uniform texture with corrugations $\frac{1}{16}$ inch to $\frac{1}{8}$ inch deep.
 - 3. Use turf with a blade density of 7,200 blades/ft² and each blade at least $\frac{3}{4}$ inch long.
 - 4. Continuously monitor the texturing operation.
 - 5. Weight the turf if necessary to produce an acceptable texture using a uniformly distributed load.
 - 6. Remove buildup of cementitious or other materials that may produce an uneven or unacceptable texture.
- E. Grinding may be required to correct unacceptable texturing.
- F. Rumblestrips
 - 1. Install by diamond grinding when required.
 - 2. Rotomilling is not an acceptable method of installation.

3.7 CURE

- A. Apply concrete curing compound to the entire pavement surface and exposed edges immediately after completing finishing operations.
 - 1. Apply the concrete curing compound in two approximately equal applications.
 - 2. Apply the second application in the opposite longitudinal direction as the first at a combined application rate equal to 100 ft²/gal.
 - 3. Allow at least 30 minutes between applications.
 - 4. Hand spray small and irregular areas and areas inaccessible to mechanical spraying equipment.
- B. Stop the paving operations until the problem is resolved if the concrete curing compound application behind the paving machine is delayed.
 - 1. Use fogging to keep the pavement moist until the concrete curing compound application resumes.
 - a. Use fogging equipment with compressed air misters that atomize the water and produce a very fine mist and not a spray.
 - b. Use equipment that allows for adjusting the rate of fogging depending on the conditions that are present.

- c. Maintain misters at least 5 ft above the concrete surface and aimed in a direction above horizontal.
 - d. Do not use fogging to apply excess water to the concrete surface to aid finishing.
 - e. Do not affect the water/cement ratio of the concrete.
 - f. Discontinue fogging when a fine coating of water or sheen is visible on the concrete surface.
- 2. Prevent damage to the pavement surface texture.

3.8 PROTECTION

- A. Protect pavement against damage and marring.
 - 1. Construct crossings to bridge the concrete when necessary, as approved by the Engineer.
- B. Do not allow hauling equipment or traffic on the pavement until 100 percent of the specified 28-day minimum compressive strength has been achieved. Verify strength by one of the following:
 - 1. Maturity method – AASHTO T 325
 - 2. Cast cylinders
- C. Do not permit hauling equipment or traffic on the pavement before all sawed joints are sealed.

3.9 JOINTS

- A. Construct contact joints, sawed joints, and transverse expansion joints as shown in the plans and approved joint layout.
- B. Keep the joint faces at right angles to the top pavement surface with longitudinal joints parallel to the centerline and coinciding with the traffic lane lines.
- C. Longitudinal Contact Joints
 - 1. Do not allow the finished surface across longitudinal contact joints to deviate from a straight line by more than $\frac{1}{4}$ inch in 10 ft when tested with a straight edge.
 - 2. Cease operations until specified tolerances are achieved if the edge slump requirements are not satisfied within 200 ft.
 - 3. Repair the edge by the following procedures if the edge slump exceeds the specified $\frac{1}{4}$ inch in 10 ft before placing adjacent concrete:
 - a. Saw off the slumped edge to the full thickness with a diamond saw.
 - b. Drill holes in the sawed edge and epoxy in new tie bars.

- c. Profile grinding may be considered as approved by the Engineer.
- 4. Straighten bent tie bars and re-coat with epoxy paint at the bend point before placing concrete in the adjacent lane.
- D. Transverse Contact Joints
 - 1. Construct transverse contact joints normal to the centerline without keyways on the vertical face.
 - 2. Use No. 10 by 18 inch dowel bars placed midpoint in the slab at 12 inches on center and embedded 9 inches on each side.
 - 3. Form joints with bars placed through the form or saw joints with bars drilled and epoxied.
- E. Longitudinal and Transverse Sawed Joints
 - 1. Single cut all transverse and longitudinal joints. Refer to PV Series Standard Drawings.
 - 2. Saw joints before uncontrolled cracking occurs.
 - 3. Conduct continuous sawing operations during both day and night regardless of weather conditions.
 - 4. Provide lighting during nighttime sawing.
 - 5. Thoroughly clean and dry joints before placing sealant.
 - a. Clean the joint using at least 100 psi air.
 - b. Equip air compressors with operating oil and water traps.
 - 6. Fill the joints to within ¼ inch of the finished surface with joint sealer.
 - a. Remove and replace joint sealer of overfilled joints.
 - 7. Match joints in adjacent lanes to form a continuous line across the pavement width including the concrete shoulders.

3.10 FILL PAVEMENT CORE HOLES

- A. Fill the core holes with the same concrete mix or other product approved by the Engineer within 24 hours after coring.
- B. Verify the holes are cleaned with no standing water before filling with concrete.
- C. Consolidate the concrete by rodding or vibrating.
- D. Strike off level with the pavement surface and texture.
- E. Protect concrete in core holes from any damage for at least 48 hrs.

3.11 DEFECTIVE PAVEMENT PANELS

- A. The Engineer determines defective panels before substantial completion.

- B. Repair or replace defective pavement panels.
 - 1. Complete repairs before acceptance testing for smoothness.
- C. Remove and replace panels when multiple full depth cracks separate the panel into three or more pieces.
- D. Use methods that do not disturb or damage adjacent panels.
- E. Remove and replace panel with any full depth transverse crack within 4 ft or less of a transverse sawed joint.
- F. Drill and epoxy tie-bars/dowel bars as required into existing pavement.
- G. Match the profile and texture of existing pavement.
- H. Repair any crack connecting joints appearing before substantial completion.
 - 1. Rout to a 1 inch depth by $\frac{1}{8}$ inch width and seal with silicone sealant. Refer to Section 03152.
- I. Leave tight random cracks less than $\frac{1}{64}$ inch wide undisturbed.

3.12 LIMITATIONS – GENERAL

- A. Meet limitations of Section 03055 except as modified below.
- B. Night Operations
 - 1. Provide proper lighting from $\frac{1}{2}$ hour after sunset to $\frac{1}{2}$ hour before sunrise according to Section 00555.
- C. Precipitation
 - 1. Cease operation when rain is threatening.
 - 2. Remove, replace, or repair any pavement damaged by rain or hail as determined by the Engineer.
 - a. Pavement is considered damaged when rain or hail leaves noticeable texture on the surface.
 - b. Do not finish rainwater or hail into the concrete surface.
- D. Surface Evaporation
 - 1. Limitations apply at any time of the year when any combination of air temperature, relative humidity, and wind velocity have the potential to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties.
 - 2. Prepare materials required for evaporation control measures and have them available on site.

3. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and wind velocity have the capacity to evaporate water from a free water surface at a rate equal to or greater than 0.2 lb/ft²/hr.
 - a. Determine the evaporation rate of surface moisture by the Menzel Formula. Refer to ACI 305.1.
- E. Mix Consistency
 1. Cease operations when three consecutive paving sublots warrant acceptance at a reduced rate due to compressive strength.
 2. Cease operations upon having four consecutive batches rejected due to noncompliant air content of the mix.
 3. Do not resume paving operations until the issues have been resolved to the satisfaction of the Engineer.
 - a. Delays due to ceased operations are not excusable.

3.13 LIMITATIONS – COLD WEATHER

- A. Cold weather limitations apply when the temperature is forecast to fall below 40 degrees F within 14 calendar days of placement.
- B. Comply with the following requirements for placing concrete in cold weather:
 1. Do not use chemical additives in the concrete to prevent freezing.
 2. Provide all necessary cold weather protection for in-place concrete using items such as covers, insulation, and heat.
 3. Do not place concrete in contact with frozen surfaces.
 4. Adequately vent combustion-type heaters that produce carbon monoxide.
 5. Protect the concrete from freezing when the ambient air temperature is 36 degrees F or below until a compressive strength of 3,500 psi has been achieved, determined by either:
 - a. Maturity method – AASHTO T 325
 - b. Field cure cylinders
 6. Maintain moist conditions for exposed concrete to avoid loss of moisture from the concrete due to heat applied.
 7. Limit the drop in temperature next to the concrete surfaces when removing heat to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.
 8. Measure, monitor, and record the concrete surface temperature at the frequency in the approved cold weather protection plan.
 - a. Provide the data to the Department within 24 hours of measurement.
 9. Paving may begin when base surface temperature is 36 degrees F in the shade and rising.

10. Cease operations when the ambient temperature is 45 degrees F in the shade and decreasing.
 11. Remove and replace concrete when any portion of the panel has frozen.
 12. Do not use material containing frost or lumps.
- C. Heating Aggregate and Water
1. Provide and operate heating devices when heated aggregates are required.
 2. Use aggregates free of ice.
 3. Heat aggregates uniformly, avoid overheating or developing hot spots.
 4. Use either steam or dry heat.

3.14 LIMITATIONS – HOT WEATHER

- A. Comply with approved hot weather protection plan when ambient air temperature is 85 degrees F to 100 degrees F in the shade.
- B. Discontinue paving when ambient air temperature exceeds 100 degrees F in the shade.

END OF SECTION

SECTION 02753

FULL DEPTH SLAB REPLACEMENT FOR CONCRETE PAVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Remove full panel or partial panel of existing pavement.
- B. Clean, grade, and reconsolidate base.
- C. Install dowels and tie bars.
- D. Replace and cure repair material.

1.2 RELATED SECTIONS

- A. Section 02752: Portland Cement Concrete Pavement
- B. Section 03055: Portland Cement Concrete
- C. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 235: Epoxy Resin Adhesives
- B. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.
- B. Sample of the end caps for approval before use on the project.

PART 2 PRODUCTS

2.1 FULL DEPTH CONCRETE PAVEMENT REPAIR MATERIAL

- A. Refer to Section 02752. It is acceptable to:
 - 1. Use high range water reducers such as Super Plasticizers.
 - 2. Accelerate the rate of concrete strength gain to match the field placement schedule with permission from the Engineer.
- B. Use an Epoxy Resin Adhesive according to AASHTO M 235. Select Type and Class for the application.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove panel or panel section.
 - 1. Determine the extent and dimensions of the repair from the plan sheets or as directed by the Engineer. Refer to PV Series Standard Drawings.
 - 2. Complete the removal and make full depth cuts around the perimeter of the rectangular section to be removed.
 - a. Minimize saw overcuts.
 - 3. Remove panels by lift-out method.
 - a. Use chains and lift pins to facilitate removal and minimize disturbance of the base material.
 - 4. Repair damage caused by removal operations to adjacent slabs and underlying base courses.
 - 5. Remove all loose particles of old Portland Cement Concrete (PCC), before placing new PCC.
- B. Reconstruct base to grade and compact to standard specifications.
- C. Form any side that does not have an adjacent panel.
 - 1. Form to match existing panels, providing a vertical edge.
- D. Place Dowel and Tie Bars
 - 1. Place bars in locations according to PV Series Standard Drawings. Use tie-bars or smooth dowels where indicated on standard drawings.
 - 2. Stockpile bars and keep them clean and free from damage.
 - 3. Drill holes mid-depth of the slab without causing damage to the remaining pavement section and meet bar placement tolerances.

4. Drill multiple holes simultaneously with drills held horizontally in a rigid frame.
 - a. Prevent drill bits from wandering.
 5. Clean holes of dust, grease, and other contaminants.
 6. Inject epoxy resin adhesive into the back of the drilled hole.
 - a. Provide sufficient quantity of bonding compound to completely fill the void between the bar and the outer limits of the drilled hole.
 - b. Rotate one full revolution while inserting bar.
 - c. Use retention rings to prevent the bonding compound from flowing out of the hole.
 7. Align bars horizontally and vertically to meet requirements of the Standard Drawings and allow them to stabilize before mix placement.
 8. Repair any bar coating damage with appropriate repair material.
 9. Place tight fitting end caps made of non-metallic materials that allow $\frac{1}{4}$ inch movement on protruding dowels used at expansion joints.
 10. Coat protruding portion of dowel bar with lubricant consisting of paraffin wax, lithium grease, or other semi-solid, inert lubricant approved by the Engineer.
 11. Remove and replace loose bars at the Contractor's expense, before placing concrete mix.
- E. Prepare existing joints for placement.
1. Maintain existing pavement joint layout.
 2. Place a bond breaker approved by the Engineer on the existing pavement edges that compose existing joints, either transverse or horizontal.
 3. Saw joint on the same line if repairs straddle an existing joint line. Saw according to Section 03390.

3.2 PLACE CONCRETE

- A. Place and consolidate concrete according to Section 02752.

3.3 FINISH CONCRETE

- A. Finish patch to $\pm \frac{1}{8}$ inch of existing profile.
1. Correct patch profiles in excess of $\frac{1}{8}$ inch higher than the existing pavement profile through surface grinding or removal and replacement.
 2. Correct patch profiles in excess of $\frac{1}{8}$ inch lower than the existing pavement profile through removal and replacement of the patch.
 3. Make any necessary corrections to the patch finish.

- B. Do not tool joints that are to be saw cut and sealed.
- C. Texture the surface to match the existing pavement.

3.4 CURE AND PROTECT CONCRETE

- A. Cure the concrete pavement. Refer to Section 03390.
- B. Do not open to traffic until 4,000 psi strength is reached. Verified by either:
 - 1. Maturity Method – Refer to AASHTO T 325.
 - 2. Cast cylinders
- C. Cut all previously existing joints to original dimensions.
- D. Fill all sawing overcuts with repair epoxy approved by the Engineer.
- E. Replacement slab must perform under traffic at specified time of opening without failure.
- F. Remove and replace defective panels. Refer to Section 02752.
- G. Protect the individual placements with approved barricades.

3.5 LIMITATIONS

- A. Refer to Section 03055 for general limitations.
- B. Refer to Section 02752 for weather limitations.

END OF SECTION

SECTION 02754

DOWEL BAR RETROFIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedures and materials for installing coated dowel bars across existing transverse joints and cracks.

1.2 RELATED SECTIONS

- A. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

- A. AASHTO T 22: Compressive Strength of Cylindrical Concrete Specimens
- B. ASTM C 157: Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- C. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete
- D. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
- E. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- F. UDOT Minimum Sampling and Testing Requirements
- G. UDOT Quality Management Plan 506

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Submit documentation from the manufacturer for approval verifying that the patching material meets the requirements of this Section, Article 2.1.
- B. Sample of the end caps for approval before use on the project.
- C. Sample of the caulking filler for approval before use on the project.

- D. Volumetric Mixer annual inspection and calibration records according to the Quality Management Plan 506.
- E. The names and contact information of at least two individuals who have experience on previous projects in all aspects of the dowel bar retrofit work.
 - 1. Provide a written summary of each individual's experience.
 - 2. One of these individuals must be present on the project site during all working hours to oversee dowel bar retrofit work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Dowel Bars – 1½ inch x 18 inch, coated smooth steel rod, according to Section 03211.
- B. Bond Breaking Compound – Use a bond-breaking compound approved by the Engineer.
 - 1. Apply bond breaking compound to the dowel bar at manufacturing facility.
- C. Chair Devices – Coat according to Section 03211 or make the devices used to support and hold the dowel bar in place out of non-metallic materials.
 - 1. Provide a minimum clearance of ½ inch between the bottom of the bar and the surface upon which the chair is placed.
 - 2. Press chairs securely against the slot faces.
- D. End Caps
 - 1. Place tight fitting end caps made of non-metallic materials on dowels to allow for ¼ inch movement of the bar at each end.
- E. Caulking Filler - A commercial caulk designed as a concrete sealant that is compatible with the patch material being used.
- F. Patching Material
 - 1. Use prepackaged concrete patching material such as Five Star Highway Patch, AHT DB Retrofit Mortar, or an equivalent as approved by the Engineer with an aggregate extension conforming to the manufacturer's recommendations.
 - 2. Use mix with 100 percent of washed aggregate passing the ¾ inch screen.

3. Select patching material that meets the performance criteria listed in Table 1.

Table 1

Patching Material		
Compressive Strength	Test Method	Value
At 3 hours	AASHTO T 22	3000 psi
At 24 hours	AASHTO T 22	5000 psi
Shrinkage in 4 days	ASTM C 157	0.13 percent, max
Bond Strength	ASTM C 882 as modified by ASTM C 928, Section 8.5	1000 psi, minimum @ 24 hours

- G. Foam Core Board– Use a foam core board capable of maintaining the joint or crack.
 1. The foam core board must be at least 0.375 inch thick, rigid styrofoam or closed cell foam faced with poster board material or plastic faced material on each side.
- H. All testing will be performed by a testing facility certified in applicable areas as outlined in the UDOT Laboratory Qualification Program (LQP).

2.2 EQUIPMENT

- A. Use jackhammers equal to or less than the nominal 30 lb class to prevent damage to adjacent or underlying concrete pavement.
- B. Use gang mounted saws capable of cutting at least 3 slots per wheel path simultaneously and vacuuming water and paste residue from surface immediately after sawing.
- C. Meet the requirements of the Quality Management Plan 506 for volumetric mixers if used.

PART 3 EXECUTION

3.1 CONSTRUCTION

- A. Test Section
 1. Provide a test section consisting of at least 24 complete dowel bar retrofits at a location determined by the Engineer before beginning production work.
 - a. Take three 6 inch diameter full-depth cores at locations determined by the Engineer 24 hours after completing the test section to assess the installation.
 - 1) Inspect the cores in the presence of the Engineer.

- 2) Verify proper dowel placement and that there are no voids around the bar circumference.
 - 3) Repair core holes using the approved patching material.
 - 4) Inspect cured patching material for cracking.
 - b. Begin production work after obtaining the Engineer's approval.
 2. Additional cores may be required on subsequent production days following test section approval at the discretion of the Engineer.
- B. Saw cut the dowel slot into pavement as shown in the PV Series Standard Drawings.
- C. Use jackhammer for concrete removal in cut slot areas.
- D. Sand or water blast to clean all exposed surfaces and cracks removing slurry and loose concrete.
1. Demonstrate acceptable results if using water blasting.
 2. Use water blasting equipment capable of producing a minimum of 3,000 psi.
 3. Produce a flat level surface on slot bottom.
- E. Clean up and properly dispose of all residues from the saw, jackhammer, sand or water blasting process, and any other sources.
1. Re-clean patching areas as determined by the Engineer if work is delayed for any reason.
- F. Place caulking filler in existing joint or crack to prevent intrusion of patching material.
1. Dry and clean surface receiving caulk.
 2. Refer to PV Series Standard Drawings.
- G. Place the foam core board on the dowel bar in line with the transverse joint or crack.
- H. Fit the foam core board tightly around the dowel bar and to the bottom and edges of the slot.
- I. Maintain the foam core board in a vertical position and tight to all edges during placement of the patching material.
1. Adjust the height of the foam core board by cutting so it does not extend above the pavement surface.
- J. Place bars so that the bars do not extend more than 11 inches past the centerline of the slot.

- K. Provide a minimum space of ½ inch in all directions around bar.
- L. Thoroughly dampen concrete surfaces of the slot immediately before filling with patching material.
 - 1. Prevent standing water in the slot.
 - 2. Remove all excess water with compressed air.
- M. Fill the slot with patching material.
 - 1. Consolidate the material in the slot and around the dowel bar with an appropriate size vibrator.
 - 2. Place and cure the patching material according to manufacturer's requirements using a curing compound meeting ASTM C 309, Type 1D, Class A.
 - 3. Require a representative from the manufacturer of the patching material to be on site for the first day's placement.
 - 4. Retrofits cannot be higher than ¼ inch in relation to existing pavement before grinding.
 - 5. Finished dowel bar retrofits must be flush with pavement after grinding operations.
- N. Protect the retrofit from traffic until the patching material achieves a compressive strength of 3,000 psi as tested according to AASHTO T 22.
 - 1. Test in accordance with the UDOT Materials Sampling and Testing Requirements.
- O. Prevent any individual dowel bar retrofit from becoming delaminated, spalled, debonded, cracked, or honeycombed.
- P. Begin pavement grinding within 10 working days of placing dowel bar retrofit patching materials.
 - 1. Continue grinding operations without interruption until completed.
- Q. Remove foam core board as needed and repair to a depth of 2 inches and reseal.

END OF SECTION

SECTION 02755

CONCRETE SLAB JACKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Injection of a product to raise and support a failed section of concrete pavement back to grade for a suitable ride.

1.2 RELATED SECTIONS

- A. 02705 – Pavement Cutting

1.3 REFERENCES

- A. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- C. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
- D. ASTM D 1622: Apparent Density of Rigid Cellular Plastics

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Copies of invoices from mix suppliers for information.
- B. Manufacturer's product data sheet and recommended installation instructions.
- C. A warranty letter guaranteeing all materials and workmanship for a period of one year.
 - 1. The guarantee period starts on the date of Substantial Completion.
 - 2. Include in the letter:
 - a. State Project Designation
 - b. State Project Name
 - c. Contractor and Installer Name
 - 3. Defects (performance failures) include:
 - a. Re-settling of treated areas beyond 1/8 inch of finished grade profile

4. The guarantee covers 100 percent of the concrete slab jacking costs.
5. Replace by re-injection or slab replacement any material that fails during the warranty period.

1.8 PAYMENT PROCEDURES

- A. Liquid quantities of non-shrink grout measured using a calibrated meter paid for at the contract unit price per cubic yard.
- B. Liquid quantities of High-Density Polyurethane measured using methods approved by Engineer paid for at the contract unit price per pound.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYURETHANE

- A. Use water based formulation of expanding high-density polyurethane that sets to full compressive strength within 15 minutes after injection to raise slabs.

Table 1

High-Density Polyurethane		
PROPERTY	ASTM	LIMITS
Density	D 1622	Min 3.8 lb/ft ³ - Max 4.3 lb/ft ³
Tensile Strength	D 790*	Min. 80 psi
Elongation	N/A	Max. 5.1%
Compressive Strength at Yield Point	D 1621	Min. 60 psi

*Use the value of flexural strength or flexural yield as tensile strength.

2.2 NON-SHRINK GROUT

- A. Use packaged dry, hydraulic-cement grout (non-shrink) according to ASTM C 1107.

2.3 EQUIPMENT

- A. Equipment capable of supplying a homogenous product at the appropriate rate.
- B. Certified scales or measuring devices to measure delivered product and to proportion product components.

- C. Concrete drill or saw capable of producing circular holes of adequate size for the application type.
- D. Elevation measuring devices with an accuracy of $\frac{1}{8}$ inch.
- E. Concrete saw capable of cutting joints between failed and non-failed slabs.

PART 3 EXECUTION

3.1 PREPARATION

- A. Establish a finish target profile of pavement using elevation measuring device or string lines.
- B. Saw cut joints between failed and non-failed slabs as necessary to prevent damage to non-failed slabs. Refer to Section 02705.

3.2 INSTALLATION

- A. Drill holes as necessary in roadway slab.
- B. Inject product to evenly raise slab to finished grade profile.
- C. Fill injection holes with at least 4 inches of non-shrink grout.
- D. Final grade after jacking must be within $\pm \frac{1}{8}$ inch of finished grade profile.

END OF SECTION

SECTION 02761

LONGITUDINAL RUMBLE STRIP

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Longitudinal rumble strip on the final roadway surface.

1.2 RELATED SECTIONS

- A. Section 01558: Temporary Pavement Markings
- B. Section 02742S: Project Specific Surfacing Requirements

1.3 REFERENCES Not Used

1.4 DEFINITIONS

- A. HMA – Hot Mix Asphalt Pavement
- B. PCCP – Portland Cement Concrete Pavement
- C. SMA -- Stone Matrix Asphalt Pavement

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

- A. The grinds will be visually inspected at the start of installation and inspected at a minimum of once a day for each day of production, to verify a uniform application rate of asphalt flush coat or seal coat and compliance with the PV Series Standard Drawings for dimensions and spacing.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Install longitudinal rumble strip with equipment using a rotary type cutting head capable of obtaining the required groove width, depth and length in a single pass while moving in the same direction as the traffic flow.

1. Use equipment with cutting heads having an independent suspension from the power unit to allow the head to self align with the slope of the shoulder.
 2. Use cutting heads that provide a smooth surface, approximately $\frac{1}{16}$ inch between peaks or valleys.
- B. Seal longitudinal rumble strip with equipment capable of obtaining the required uniform application rate in a single pass while moving in the same direction as the flow of traffic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install longitudinal rumble strip to the dimensions and spacing as shown in PV Series Standard Drawings.
1. Establish lane widths from plan set or existing roadway if not shown, before installation of longitudinal rumble strip.
 2. Install longitudinal rumble strip after the final wearing course except when project includes a chip seal coat as the final wearing course.
 - a. Install rumble strip before applying chip seal.
- B. Alignment Control
1. Establish a control line using a dribble/drip line, temporary pavement marking material, or permanent application of pavement marking material according to Section 01558 in its permanent configuration and location before the installation of longitudinal rumble strip.
 - a. Establish control points at intervals no greater than 100 ft on tangents and no greater than 50 ft on curves.
 2. Maintain the longitudinal rumble strip within 2 inches of the nearest edge of control line.
 - a. Maintain the grind dimensions within 10 percent of the width, depth and length dimensions defined in the PV series Standard Drawings.
- C. Construct a 500 ft long test section each production day to demonstrate that the equipment, personnel, and methods of operation are capable of producing acceptable results.
1. Do not proceed with work until it is demonstrated that the required dimensions, alignment, and smoothness can be achieved without tearing or otherwise damaging the pavement.
 2. Do not proceed with work until it is demonstrated that the uniform application of asphalt flush coat or seal coat is being achieved at the specified application rate over the required area.

3. Replace or deduct price paid for longitudinal rumble strip not installed according to PV series Standard Drawings as follows;
 - a. Deduct 25 percent for longitudinal rumble strip installed within 2 inches of allowable tolerance.
 - b. Deduct 50 percent for longitudinal rumble strip installed greater than 2 inches but less than 4 inches out of allowable tolerance.
 - c. Remove and replace longitudinal rumble strip greater than 4 inches out of allowable tolerance by milling 2 inches deep from final pavement surface and three times the rumble strip width.
 - d. Fill milled section with like material and reinstall longitudinal rumble strip according to PV Series Standard Drawings.
- D. Clean the surface of dirt, sand, dust, and other objectionable material to the satisfaction of the Engineer before applying asphalt flush coat.
- E. Apply asphalt flush coat or seal coat on asphalt surfaces excluding chip seals after longitudinal rumble strip have been installed in the roadway.
 1. Apply asphalt flush coat on asphalt surfaces at a uniform application rate according to Section 02742S.
 2. Refer to Section 02742S for asphalt flush coat or seal coat material.
 3. Adjust speed and application method to achieve uniform application rate and to prevent shadow areas of thinner application depths according to this Section, Paragraph 2.1 B.
- F. Do not apply flush coat on PCCP surfaces.
- G. Remove resulting debris before opening the adjacent lane to traffic.
 1. Dispose of material according to Federal, State, and Local regulations.

END OF SECTION

SECTION 02765

PAVEMENT MARKING PAINT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish acrylic water-based pavement marking paint. Refer to this Section, Article 2.2 for resin requirement.
- B. Apply to hot mix asphalt or portland cement concrete pavement as longitudinal lines, transverse markings, contrast lines, and other related markings.
- C. Remove pavement markings.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 247: Glass Beads Used in Traffic Paints
- B. ASTM D 562: Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
- C. ASTM D 1155: Roundness of Glass Spheres
- D. ASTM D 1475: Density of Liquid Coatings, Inks, and Related Products
- E. ASTM D 1644: Nonvolatile Content of Varnishes
- F. ASTM D 2205: Selection of Tests for Traffic Paints
- G. ASTM D 2743: Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography
- H. ASTM D 2805: Hiding Power of Paints by Reflectometry
- I. ASTM D 3723: Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
- J. ASTM D 3960: Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

- K. ASTM D 5381: X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders
- L. ASTM E 1347: Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
- M. Environmental Protection Agency Testing Methods
- N. Federal Specification
- O. Federal Standards
- P. Manual on Uniform Traffic Control Devices (MUTCD)
- Q. UDOT Materials Manual of Instruction
- R. UDOT Minimum Sampling and Testing Requirements
- S. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Longitudinal Markings – pavement markings that are generally placed parallel and adjacent to the flow of traffic such as lane lines, center lines, edge lines, channelizing lines, and others.
- B. Transverse Markings – pavement markings that are generally placed perpendicular and across the flow of traffic such as shoulder markings; word, symbol, and arrow markings; stop lines; crosswalk lines; speed measurement markings; parking space markings; and others.
- C. Long-term stationary – work that occupies a location more than 3 days.

1.5 SUBMITTALS

- A. Documentation of the manufacturer and production batch identification for the paint used.

1.6 ACCEPTANCE

- A. Provide fixtures such as ball valves, gate valves, or others on paint truck for the purposes of obtaining field samples.

- B. The Department will:
 - 1. Accept pavement marking paint from qualified manufacturer supplied samples.
 - 2. Sample from the applicator's yard, at the Department's discretion for acceptance.
- C. Stop all agitation before sample is drawn.
- D. The Engineer will:
 - 1. Visually inspect longitudinal lines and transverse markings to verify compliance with the required dimensions.
 - 2. Inspect at the end of each production day or more frequently as required.
 - 3. Verify quantities applied by either of the following methods:
 - a. Measuring both paint and bead tanks before and after application.
 - b. Witnessing the meter readings before and after application.
 - 1) A printout of meter readings instead of witnessing may be accepted at the Engineer's discretion.
 - 4. Sample in the field according to the UDOT Quality Management Plan 513, Pavement Marking Paint and the UDOT Minimum Sampling and Testing Requirements.
- E. Repaint any line or legend failing to meet bead application rates and dimensional requirements.
 - 1. Do not remove earlier application.
- F. Price Reductions
 - 1. Price reductions for pavement markings installed below the specified wet mil thickness are outlined in Table 1.

Table 1

Price Reduction for Wet Mil Thickness	
	Pay Factor
Less than 2 percent below the specified mil thickness	1.00
Less than 10 percent below the Specified wet mil thickness	0.75
Less than 15 percent below the Specified wet mil thickness	0.50
15 percent or more below the Specified wet mil thickness	0.00 *

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.

2. The Department will apply price reductions for applied pavement markings that do not meet the requirements of Table 4 when the batch is sampled at the applicator's yard for quality verification according to UDOT Quality Management Plan 513, Pavement Marking Paint.
 - a. Apply the lowest pay factor from Tables 2 and 3.
3. The Department will require repainting for pavement markings more than five percentage points below total solids, pigment, or non-volatile vehicle properties from Table 4 when the project is sampled for quality verification according to Minimum Sampling and Testing Requirements.

Table 2

Price Reduction for Total Solids, Pigment and Non-Volatile Vehicle	
	Pay Factor
Less than 0.5 percent below or above the specified percentage	1.00
Less than 1.0 percent below the specified percentage	0.95
Less than 2.0 percent below the specified percentage	0.85
2.0 percent or more below the specified percentage	0.00 *

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.

Table 3

Price Reductions for remaining requirements of Table 4	
	Pay Factor
Less than 0.2 percent deficient	1.00
Less than 1 percent deficient	0.90
Less than 2 percent deficient	0.80
Less than 3 percent deficient	0.70
Less than 4 percent deficient	0.60
Less than 5 percent deficient	0.50
5 percent or more below specified quantitative requirements	0.00 *

* Repaint pavement markings at no cost to the Department. Do not remove earlier application.

PART 2 PRODUCTS

2.1 PAINT

- A. Meet the requirements for Acrylic Water Based Paint specified in Table 4.

Table 4

Paint Requirements				
Property	White	Yellow	Black	Test
Pigment – Percent by weight, minimum	62.0	62.0	62.0	ASTM D 3723
Total Solids – Percent by weight, minimum	77.0	77.0	77.0	ASTM D 1644
Nonvolatile vehicle – Percent by weight vehicle, minimum*	43.0	43.0	43.0	ASTM D 3723 ASTM D 1644
Viscosity, KU @ 77 degrees F	80 – 95	80 – 95	80 – 95	ASTM D 562
Density, lb/gal, minimum	14.0	14.0	14.0	ASTM D 1475
Volatile Organic Content (VOC) – g/L, maximum	100	100	100	ASTM D 3960
Titanium Dioxide Content, lb/gal	1.0 min	0.2 max	N/A	ASTM D 5381
Color Definition	37875	33538	N/A	Federal Standard 595B
Directional Reflectance Minimum	90.0	50.0	N/A	ASTM E 1347
Dry Opacity – Minimum (5 mils wet)	0.95	0.95	N/A	ASTM D 2805

* Binder – 100 percent acrylic cross-linking polymer, by weight, as determined by infrared analysis and other chemical analysis available to the Department. Refer to ASTM D 2205.

- B. No-Pick-Up Time
1. Paint may not smear or track three minutes after application to the roadway using standard application equipment, at the mil thickness required, and with an ambient shaded temperature of at least 50 degrees F.
- C. Additional Requirements
1. Free of lead, chromium, or other related heavy metals. Refer to ASTM D 5381.
 2. Refer to ASTM D 2743 and ASTM D 5381 for tests used to verify paint samples meet ASTM requirements.

2.2 GLASS SPHERES (BEADS) USED IN PAVEMENT MARKING PAINT

- A. Heavy metal concentration: Manufacturer must provide a certificate of compliance stating that all beads contain no more than the amounts listed for the following materials as determined by testing performed according to EPA test methods 3052 and 6010C.

1. Other suitable x-ray fluorescence spectrometry analysis methods may be used to screen samples of glass spheres for arsenic, antimony and lead content.

Table 5

Heavy Metal Materials	
Material	Level (ppm, total)
Arsenic	200
Antimony	200
Lead	200

- B. Longitudinal Lines – Refer to AASHTO M 247, Specific Properties, with the following exceptions:

1. Gradation:

Table 6

Gradation	
Sieve Size	Accumulated Percent Passing
No. 18	65 – 80
No. 30	30 – 50
No. 50	0 – 5

2. Coating – Dual coating for optimum adhesion and embedment.
3. Roundness – 80 percent true spheres below the number 30 sieve. Refer to ASTM D 1155
4. Color/Clarity – Colorless/clear and free of carbon residue.
5. Refractive Index – Minimum 1.51 by oil immersion method.
6. Air Inclusions – Less than 5 percent by visual inspection.
7. Hardness – Beads above the number 30 sieve exhibit an average hardness of C70.5 when measured using the Rockwell C scale method and using a minimum sample of 100 beads.
8. Crushing Strength – Beads above the number 30 sieve exhibit an average crushing strength of 60,000 psi when measured by the L/D^2 method and with a minimum sample of 100 beads.
9. Chemical Resistance – Beads resistant to hydrochloric acid, water, calcium chloride, and sodium sulfide. TT-B Federal Specification 1325C sections 4.3.6 to 4.3.9.

- C. Transverse Markings – Refer to AASHTO M 247, Specific Properties, with the following exceptions:

1. Gradation:

Table 7

Gradation	
Sieve Size	Accumulated Percent Passing
No. 20	90 – 95
No. 30	45 – 70
No. 50	5 – 25
No. 80	0 – 5

2. Coating – Dual coating for optimum adhesion and embedment.
3. Roundness – The glass beads will have at least 75 percent true spheres.
4. Refractive index – Minimum 1.51 by oil immersion method.
5. Air Inclusions – Less than 10 percent by visual inspection.
6. Have at least 80 percent true spheres.
- D. Beads used in Temporary Pavement Markings. Meet the above or AASHTO M 247 Type II uniform gradation.

PART 3 EXECUTION

3.1 PREPARATION

- A. Line Control
1. Establish control points at 100 ft intervals on tangent and at 50 ft intervals on curves.
 2. Maintain the line within 2 inches of the established control points and mark the roadway between control points as needed.
 - a. Remove paint that is not placed within tolerance of the established control points and replace. Refer to this Section, Article 3.4.
 - b. Maintain the line dimension within 10 percent of the width and length dimensions defined in Standard Drawings.
- B. Remove dirt, loose aggregate, curing compounds, and other foreign material and follow manufacturer's recommendations for surface preparation.

3.2 APPLICATION

- A. Use Qualified Applicators as identified in UDOT Quality Management Plan 513, Pavement Marking Paint.

- B. Apply Pavement marking paint at the following wet mil thickness:
1. 20-25 wet mils for all longitudinal markings.
 2. **Approximate** application rate for required mil thickness requirements:
 - a. 4 inch Solid Line – From 190 to 240 ft/gal
 - b. 4 inch Broken Line – From 760 to 960 ft/gal
 - c. 8 inch Solid Line – From 95 to 120 ft/gal. Use the following calculation to determine wet mil thickness if approximation is outside the range for the desired line type.

Calculation – Determine wet mil thickness

$$4 \text{ inch Solid Line – Wet mils} = \frac{4812.516 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}$$

$$4 \text{ inch Broken Line – Wet mils} = \frac{19250.064 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}$$

$$8 \text{ inch Solid Line – Wet mils} = \frac{2406.258 \text{ ft}^3/\text{gal mil/ft}}{X \text{ ft/gal}}$$

Where:

X = application rate. (Meter readings or dipping tanks).

- C. Refer to Table 1 for price reduction of pavement markings that are less than required wet mils in thickness.
- D. No additional payment for pavement markings placed in excess of required wet mils in thickness or exceeding dimensional requirements outlined in this Section, Article 3.2 paragraph B.
- E. Glass Sphere (Beads) – Apply at least 8 lb/gal of paint, the full length and width of line and pavement markings.
1. Calibrate bead guns and measure bead distribution according to UDOT Materials Manual of Instruction 932, Procedure for Sampling and Accepting Pavement Marking Paint and Beads.
 2. Do not apply glass beads to contrast lines (black paint).
- F. Begin striping operations no later than 24 hours after notification by the Engineer.
1. Apply two applications on new bituminous surfaces.
 - a. Verify timing of second application with the Engineer.

- G. Apply lines and pavement markings only when the air and pavement temperature are:
 - 1. 50 degrees F and rising for Acrylic Water Based Paint.
 - a. Non-grooved lines and markings applied at temperatures below 50 degrees F are temporary and must be repainted, when temperature conditions are met.
 - 1) Do not remove earlier application.
 - b. Grooved lines and markings applied below 50 degrees F must be removed and reapplied when temperature conditions are met.
- H. Comply with TC Series Standard Drawings.

3.3 CONTRACTOR QUALITY CONTROL

- A. Adhere to the requirements of UDOT Quality Management Plan 513, Pavement Marking Paint

3.4 REMOVE PAVEMENT MARKINGS

- A. Use equipment specifically designed for removal of pavement marking material.
- B. Use one of these removal methods
 - 1. High pressure water spray
 - 2. Sand blasting
 - 3. Shot blasting
- C. Do not use grinding without approval from the Engineer.
 - 1. The Engineer will consult with the Region Traffic Operations Engineer before issuing approval.
- D. Do not eliminate or obscure existing striping, instead of removal, by covering with black paint or any other covering.
 - 1. The Engineer may approval for use of black paint or other obscuring material prior to installation for work durations shorter than “long term stationary” as defined in this Section, Article 1.4 and in the Temporary Traffic Control section of the MUTCD.

END OF SECTION

SECTION 02768

PAVEMENT MARKING MATERIALS

(Warranty Specification)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pavement Marking Tape, Pavement Marking Epoxy, Methyl-Methacrylate, and Thermoplastic legends.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. Code of Federal Regulations, Title 40, Chapter 1, Subchapter C, part 59

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. A warranty letter to the Engineer and the Department Engineer for Maintenance stating that the manufacturer guarantees the product against material and installation defects incurred under traffic for the service life.
 - 1. The guarantee period starts on the date of Physical Completion.
 - 2. Include in the letter:
 - a. State Project Designation
 - b. State Project Name
 - c. Quantities
 - d. Surface type
 - e. Material type
 - 3. Defects (performance failures) include:
 - a. Loss of retro-reflectivity
 - b. Loss of presence.
 - 4. The guarantee covers 100 percent of the pavement marking materials and installation costs.
 - 5. Removal and replacement of the pavement marking for failed segment.
 - 6. The Department will notify the manufacturer of defects to be repaired during the guarantee period.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. According to manufacturer's recommendations.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING TAPE

- A. Preformed adhesive tape with a raised profile for longitudinal lines on all pavement surfaces.
- B. Preformed adhesive tape with a flat or raised profile for legends and symbols on all pavement surfaces.
- C. Minimum service life for the following applications under all traffic volumes and wear conditions:

TYPE	ELEVATION (ft above mean sea level)	INSTALLATION METHOD	MIN. SERVICE LIFE
Longitudinal lines	All	Hot inlay	48 months
Longitudinal lines	0 to 5499	Grooved	72 months
Longitudinal lines	5500 or more	Grooved	48 months
Legends and symbols	All	All	24 months

Table 1

- D. Performance measures for retro-reflectivity and presence.
 - 1. Minimum retro-reflectivity
 - a. White longitudinal lines 125 millicandelas
 - b. Yellow longitudinal lines 125 millicandelas
 - c. Legends and symbols 125 millicandelas
 - 2. Minimum presence level – 90 percent of the longitudinal line on any 1,000 ft segment or 90 percent of the legend and symbol must be present.
 - 3. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line in any 1,000 ft segment or 90 percent of a legend or symbol is considered a complete failure of that marking and requires complete replacement by the manufacturer.

2.2 PAVEMENT MARKING EPOXY

- A. Use 100 percent lead free, two-component (resin and hardener) epoxy system for longitudinal lines, legends, and symbols for all pavement surfaces.

- B. Minimum service life for the following applications under all traffic volumes and wear conditions:
1. Type 1 - Fast dry
 - a. Longitudinal – Center, skip, and edge lines 24 months
 - b. Legends and symbols 12 months
 2. Type 2 - Slow dry
 - a. Longitudinal – Center, skip, and edge lines 48 months
 - b. Legends and symbols 24 months
- C. Performance measures for retro-reflectivity and presence.
1. Minimum retro-reflectivity
 - a. White longitudinal lines 125 millicandelas
 - b. Yellow longitudinal lines 125 millicandelas
 - c. Legends and symbols 125 millicandelas
 2. Minimum presence level – 90 percent of the longitudinal line on any 1,000 ft segment or 90 percent of the legend and symbol must be present.
 3. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line in any 1,000 ft segment or 90 percent of a legend or symbol is considered a complete failure of that marking and requires complete replacement by the manufacturer.
- D. Use beads according to manufacturer's recommendations.

2.3 METHYL METHACRYLATE

- A. Use a two-component pavement marking system compliant with Federal and State VOC regulations used for longitudinal lines, legends, and symbols and for use on all pavement surfaces.
- B. Minimum surface life for the following applications under all traffic volumes and wear conditions:
1. Longitudinal lines 48 months
 2. Legends and symbols 18 months
- C. Performance Measures for retro-reflectivity and presence.
1. Minimum retro-reflectivity
 - a. White Longitudinal markings 125 millicandelas
 - b. Yellow Longitudinal markings 125 millicandelas
 - c. Legends and Symbols 125 millicandelas
 2. Minimum presence level – 90 percent of the longitudinal line on any 1,000 ft segment or 90 percent of the legend and symbol must be present.

3. Failure to meet any of the specified performance measures on at least 90 percent of the longitudinal line in any 1,000 ft segment or 90 percent of the legend or symbol is considered a complete marking failure and requires complete replacement by the manufacturer.

D. Use beads according to manufacturer's recommendations.

2.4 PREFORMED THERMOPLASTIC HEAT FUSED PAVEMENT MARKING MATERIALS

A. Use for legends and symbols only, on all pavement surfaces.

B. Heat-fused preformed and sprayed pavement marking materials.

C. Minimum service life for legends and symbols under all traffic volumes and wear conditions is 24 months.

D. Performance measures for retro-reflectivity and presence.

1. Minimum level of retro-reflectivity – 125 millicandelas
2. Minimum presence – 90 percent of the each legend or symbol must be present.
3. Failure to meet any of the specified performance measures on at least 90 percent of the legend or symbol is considered a complete failure of that legend or symbol and requires complete replacement by the manufacturer.

2.5 HOT MELT THERMOPLASTIC PAVEMENT MARKING MATERIALS

A. Use for longitudinal lines only, on all pavement surfaces.

B. Minimum service life for long lines – 24 months.

1. Applies under all traffic volumes and wear conditions.

C. Performance measures for retro-reflectivity and presence.

1. Minimum retro-reflectivity – 125 millicandelas.
2. Minimum presence – 90 percent of each legend or symbol present.
3. Failure to meet any of the specified performance measures on at least 90 percent of the legend or symbol is considered a complete failure and requires complete replacement by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare pavement surface according to manufacturer's recommendations.

3.2 APPLICATION

- A. Apply pavement marking materials according to manufacturer's recommendations.

END OF SECTION

SECTION 02771

ADA PEDESTRIAN ACCESS RAMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Americans with Disabilities Act (ADA) pedestrian access ramps.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02316: Roadway Excavation
- C. Section 02721: Untreated Base Course (UTBC)
- D. Section 02776: Concrete Flatwork
- E. Section 03055: Portland Cement Concrete
- F. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 306: Drainage, Sewer, Utility, and Related Castings
- B. ASTM A 48: Grey Iron Castings

1.4 DEFINITIONS

- A. ADA Pedestrian Access Ramp – Includes pedestrian access elements as contained on PA Series Standard Drawings.
- B. Certified Installer – The contractor or subcontractor who has successfully completed UDOT's ADA Pedestrian Ramp Training Course. Refer to <http://www.udot.utah.gov/go/standardsreferences>.

1.5 SUBMITTALS

- A. Certificate of completion of Department ADA Pedestrian Access Ramp Evaluation Training Course for information.

- B. Manufacturer's product data sheet and recommended installation instructions for detectable warning surface.
- C. Provide copy of current certificate for the Certified Installer.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(AE). Refer to Section 03055.

2.2 UNTREATED BASE COURSE

- A. Refer to Section 02721.

2.3 DETECTABLE WARNING SURFACE

- A. Use In-line truncated dome pattern that meets the requirements of PA Series Standard Drawings.
- B. Provide a color that contrasts visually with the adjoining surfaces, either light-on-dark or dark-on-light.
- C. Minimize number of panels used.
- D. Acceptable products for installation:
 - 1. Polymer Composite Panel – Epoxy polymer composition, homogenous integral color, UV stable, skid resistant, non-glare finished panel. Use modular panel size 2 ft by 4 ft or 2 ft by 2 ft, or 2 ft by 5 ft.
 - a. Use for new construction and retrofit construction.
 - 2. Precast Concrete Panel - High strength concrete with structural monofilament fibers, homogeneous integral color, UV stable, skid resistant panel. Use modular panel size 2 ft by 2 ft.
 - a. Use for new construction only.
 - 3. Gray Iron Casting
 - a. Manufactured from iron conforming to ASTM A 48 Class 35B, as specified in AASHTO M 306, uniform quality, free from sand holes, gas holes, cracks, and other surface defects.
 - b. Provide reasonably smooth, cleaned by shot blasting, free of burned-on sand skid resistant, skid resistant, weathered iron finished panel with embedment anchors.

- c. Use modular panel size 2 ft x 2 ft square or curved panels as specified.
- d. Use for new construction only.

PART 3 EXECUTION

3.1 GENERAL

- A. Have a certified ADA Pedestrian Access installer on the ADA Pedestrian Access Ramps job site at all times when they are being installed including forming.
- B. Construct as shown in PA Series Standard Drawings and project plans.

3.2 PREPARATION

- A. Construct subgrade to plan elevations. Refer to Section 02056 and Section 02316.
- B. Place and compact untreated base course.
- C. Forms
 - 1. Use wood, metal, reinforced fiberglass, or plastic forms free of warps or bends and of sufficient strength to prevent deflection during the placement of concrete.
 - a. Transition smoothly from curves to straight section.
 - 1) Keep forms in curves free of flat sections and sharp bends.
 - b. Anchor securely in place.
 - c. Clean the inside surface of all dirt, concrete, and foreign material before concrete placement.

3.3 CONCRETE CONSTRUCTION

- A. Place and finish concrete and place contraction joints according to Section 02776.
- B. Cure concrete according to Section 03390.

3.4 DETECTABLE WARNING SURFACE

- A. Polymer Composite Detectable Warning Surface Panel Installation
 - 1. Install cast-in-place detectable warning surface panel directly into the finished concrete surface according to manufacturer recommendations.
 - a. Provide a smooth transition between the panel and the surrounding concrete surface.
 - 2. Install surface applied detectable warning surface panel directly on existing concrete surface according to manufacturer recommendations and installation procedures.
 - a. Use mechanical fasteners to secure the panel to the existing surface.
 - b. Caulk a smooth transition bead along beveled panel edge and surrounding concrete surface.
- B. Precast Concrete Detectable Warning Surface Panel, and Cast Iron Plate Detectable Warning Surface Panel Installation
 - 1. Place as shown.
 - a. Install according to manufacturer's recommendations for cast-in-place method.
 - b. Provide a smooth transition between the panel and the surrounding concrete surface.

END OF SECTION

SECTION 02776

CONCRETE FLATWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete flatwork items such as sidewalk, plowable end section, median filler, curb, gutter, concrete lined ditch, and driveway.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02316: Roadway Excavation
- C. Section 02721: Untreated Base Course
- D. Section 03055: Portland Cement Concrete
- E. Section 03152: Concrete Joint Control
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 03390: Concrete Curing

1.3 REFERENCES

- A. ASTM C 979: Pigments for Integrally Colored Concrete

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. 1 ft² sample of colored concrete representative of the color provided by the Engineer for approval.
- B. Manufacturer's product data sheets and mixing instructions for concrete colorant.

1.6 ACCEPTANCE

- A. Concrete flatwork may be accepted at a reduced price when the concrete strength is below that specified.
 - 1. Refer to Section 03055 for pay factor adjustment.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(AE). Refer to Section 03055.
- B. Colorant – High purity, chemically inert, unfading, and alkali-fast synthetic pigment coloring material according to ASTM C 979.

2.2 PREMOLDED JOINT FILLER

- A. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

- A. Refer to Section 02721.

2.4 REINFORCING STEEL

- A. Coated reinforcing steel. Refer to Section 03211.

PART 3 EXECUTION

3.1 GENERAL

- A. Construct as shown in GW Series Standard Drawings and the plans.

3.2 PREPARATION

- A. Construct subgrade to plan elevations. Refer to Section 02056 and Section 02316.
- B. Place and compact UTBC per Section 02721.

- C. Forms
 - 1. Use wood, metal, reinforced fiberglass, or plastic forms free of warps or bends and of sufficient strength to prevent deflection during the placement of concrete.
 - a. Transition smoothly from curves to straight sections.
 - 1) Keep forms in curves free of flat sections and sharp bends.
 - b. Anchor securely in place.
 - c. Clean the inside surface of all dirt, concrete, and foreign material before concrete placement.
 - 2. May use slip form machines.
- D. Concrete flatwork coloring when required.
 - 1. Match concrete color to the approved samples.
 - 2. Thoroughly mix color pigment in the concrete before placing.

3.3 PLACE AND FINISH CONCRETE

- A. Dampen the subgrade just before concrete placement.
- B. Hand methods of strike-off and consolidation are permitted.
- C. Finish the surface smooth with a concrete finishing float.
 - 1. Do not add water to the surface of the concrete.
 - 2. Remove form marks and irregularities.
- D. Round edges to a $\frac{1}{2}$ inch radius.
- E. Brush exposed surfaces to a transverse broom finish except as follows:
 - 1. Provide a parallel broom finish for gutters.

3.4 EXPANSION AND CONTRACTION JOINTS

- A. Place joints perpendicular to the subgrade and as shown.
- B. Contraction Joints
 - 1. Use $\frac{1}{8}$ inch to $\frac{3}{16}$ inch thick steel plates.
 - 2. Space the joints 10 ft apart.
 - 3. Remove the templates as soon as the concrete initially sets.
 - 4. Cut joint $1\frac{1}{2}$ inch deep when using slip form method to place the concrete.

- C. Expansion Joints
 - 1. Use ½ inch thick premolded expansion joint filler.
 - 2. Place an expansion joint every 30 ft with the following exception not to place:
 - a. Slip form method to place concrete.
 - b. Gutters.
 - 3. Place joint filler between the sidewalk or median filler and the curb or adjacent pavement, sidewalk, driveway pavement, or structure.

3.5 CONCRETE CURING

- A. Refer to Section 03390.

END OF SECTION

SECTION 02785
CHIP SEAL COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for applying emulsified asphalt, followed with an application of, either a standard chip seal cover material or lightweight chip seal cover material and bituminous flush coat.
- B. Cover materials.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 01558: Temporary Pavement Markings
- C. Section 02742S: Project Specific Surfacing Requirements
- D. Section 02745: Asphalt Material
- E. Section 02765: Pavement Marking Paint

1.3 REFERENCES

- A. AASHTO T 11: Materials Finer Than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
- B. AASHTO T 19: Unit Weight and Voids in Aggregate
- C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- D. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
- E. AASHTO T 104: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- F. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

- G. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
- H. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- I. UDOT Materials Manual of Instruction
- J. UDOT Minimum Sampling and Testing Requirements
- K. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Test reports for information that the cover material and emulsion meets requirements of this Section, Part 2.
- B. Verification that the asphalt/polymer supplier adheres to UDOT Quality Management Plan for Asphalt Emulsion 508.
- C. All documentation verifying asphalt application rates, chip application, and other calibration verification for applied materials during the chip seal operations on a daily basis, or as requested by the Engineer.
- D. Vendor's bill of lading upon delivery and certify the material was diluted according to this Section, Part 2.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.

PART 2 PRODUCTS

2.1 CATIONIC EMULSIONS

- A. CRS-2A according to Section 02745.
- B. CRS-2P according to Section 02745.
- C. LMCRS-2 according to Section 02745.

2.2 HIGH FLOAT EMULSIONS

- A. HFRS-2P according to Section 02745.
- B. HFMS-2 according to Section 02745.
- C. HFMS-2P according to Section 02745.

2.3 FLUSH COAT

- A. Use the emulsion as designated in Special Provision 02742S, diluted two parts concentrate to one part water by the manufacturer.

2.4 COVER MATERIAL

- A. Use crusher processed virgin aggregate consisting of natural stone, gravel, or slag according to Table 1.
 - 1. Use crusher-processed rotary-kiln lightweight expanded shale chips meeting the requirements of Table 1 for Lightweight Chip Seal Coat.

Table 1

Chip Seal Cover Material Properties			
Test	Test Method	Standard Chip Seal Type I & II	Lightweight Chip Seal
*Unit Weight	AASHTO T 19	100 lb/ft ³ , max	60 lb/ft ³ , max
One Fractured Face	AASHTO T 335	95% minimum	
Two Fractured Faces	AASHTO T 335	90% minimum	
*LA wear	AASHTO T 96	30% maximum	30% maximum
Soundness	AASHTO T 104	10% maximum	10% maximum
Flakiness Index	Materials MOI 8-933	17 maximum	25 maximum
*Stripping	Materials MOI 8-945	10% maximum	10% maximum
*Polishing	AASHTO T 278, T 279	31 minimum	31 minimum
* The Department has the right to waive this requirement if the aggregates have proven acceptable through successful past performance as determined by the Engineer.			

- B. Meet gradation limits in Table 2. Refer to AASHTO T 27 and T 11.

Table 2

Gradation Limits			
Sieve Size	Percent Passing		
	Type I	Type II	Lightweight
½ in		100 - 98	100 - 90
¾ in	100	69 - 91	55 - 80
No. 4	0 - 15	0 - 11	0 - 5
No. 8		0 - 6	0 - 3
No. 200	0 - 1	0 - 1.5	0 - 1

2.5 BLOTTER MATERIAL

- A. Refer to Section 02748.

2.6 EQUIPMENT

- A. Use distributor trucks according to the following requirements:
1. Tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of the tank contents.
 2. Insulated tanks capable of storing the binder at temperatures that allow the binder to remain consistent with the appropriate viscosity for proper application rates.
 - a. Use tanks equipped with baffles to prevent pressure surges resulting from the asphalt sloshing in the tank when starting and stopping.
 - b. Use trucks equipped with devices to provide for accurate and rapid correlation and control of the amount of bituminous material being applied with that of the truck or distributor gauges.
 3. Constant volume circulation pumps and heaters to maintain a pressurized system so binder will be uniformly heated.
 - a. Circulation pump must spray a constant volume for the entire length of the spray bar for each application.
 4. Spray bar and nozzles designed to provide an appropriate fan width to provide uniform transverse distribution without corrugation or streaking.
 - a. Adjust the spray bar height to provide uniform distribution of binder across the application width and triple lapping of the binder on the pavement surface.
 - b. Use a fully circulating spray bar with a positive shutoff valve.

5. Computerized rate control system allowing the operator to control all distributor operations from the cab to include:
 - a. Pressure regulation of the material application and automatic rate control adjustment to the unit ground speed.
 - 1) Hydrostatic system capable of maintaining a tolerance of ± 0.03 gal/yd².
 - b. Spray bar height and width adjustment and shut off of individual spray bar sections.
- B. Use a self-propelled aggregate (chip) spreader specifically designed and manufactured for chip seal operations, equipped with the following:
1. Computerized controls that will apply a uniform, even layer of aggregate across the full width of the binder and adjust output to the unit ground speed.
 - a. Use gates adjustable to drop the correct amount of aggregate plus or minus 1 lb/yd².
 2. Variable width spreader with hydraulic control extension and adjustable discharge gates.
 3. Spreading hopper with a minimum capacity to cover a full lane of travel plus 1 ft/pass.
 4. Spinner broadcast type of aggregate spreader not allowed.
- C. Use sufficient number of dump trucks to circumvent any interruption in the supply of chips to the spreader.
1. Use tandem axle dump trucks or larger or conveyor discharge trucks to minimize the number of hook-ups.
 2. Use dump trucks with matching hitches and compatible with the aggregate spreader to provide smooth hook-ups and to minimize any spillage when loading the hopper.
 3. Use trucks in good mechanical condition and that do not leak.
 - a. Use truck tires that do not pick up binder or aggregate when driving on the new surface.
- D. Use at least three articulating type pneumatic rollers for rolling operations.
1. Use rollers weighing between 8 tons minimum and 12 tons maximum with a minimum width of 6 ft.
 2. Use rollers with pneumatic tires of equal size diameter and having treads satisfactory to the Engineer.
 3. Inflate tires so that the entire roller width area is compacted by either the rear-axle tires or the front-axle tires.
 - a. Inflate tires to 90 lb/in², or lower as approved by the Engineer.
 - 1) Maintain tire pressure within 5 lb/in².

- E. Sweeping Equipment
 - 1. Use rotary brooms with nylon or steel bristles or pickup or vacuum brooms for pavement cleaning or brooming operations.
 - a. Keep downward pressure to a minimum.
 - b. Use water as requested by the Engineer if excessive dust is generated during sweeping operations.
 - c. Use pickup or vacuum sweepers in urban areas where aggregate accumulates in gutters or where removal is required from the edge of the shoulder.
 - d. Do not dislodge embedded aggregate when brooming chip sealed roadway.
- F. Blotter Material Equipment
 - 1. Apply blotter material using a truck mounted spinner broadcast spreader.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean the road surface of all dirt, sand, dust, and other objectionable material to the satisfaction of the Engineer.
- B. Protect all structures including but not limited to guardrail, guideposts, concrete barriers, all drains, and parapet walls.
- C. Cover manholes, valve boxes, drop inlets, and other service utility entrances before placing any chip seal coat.
- D. Stockpile blotter material at least 0.25 lb/yd² according to Section 02748 at a site within 20 minutes delivery time of each road section being chip sealed.
 - 1. Have application equipment on site before beginning chip seal work.
 - a. Stockpiling of blotter material may be waived upon Engineer approval if blotter material can be obtained and ready to spread within 20 minutes of a road section being chip sealed.
 - b. Equipment to spread blotter material is subject to inspection and approval by the Engineer.

3.2 LIMITATIONS

- A. Complete all work between May 15, and August 31.
- B. Do not place chip seal coat if surface moisture is present.
- C. Place seal coat when:
 - 1. Pavement temperature is between 70 and 136 degrees F.
 - 2. Air temperature is between 50 and 110 degrees F.
 - 3. Forecasted temperature is not expected to be below 40 degrees F within 3 days after placement.
- D. Do not apply any bituminous asphalt after 6:00 p.m. if temperatures in this Section, Article 3.2, paragraph C cannot be maintained throughout all night time hours.
- E. Do not open to traffic the same day chip seal coat is placed on Interstate routes.
 - 1. Sweep and open to traffic no earlier than 6:00 a.m. the day following placement of cover material.
- F. Apply bituminous flush coat material after receiving approval from the Engineer but no earlier than 6 days after application of the cover material.
 - 1. Apply bituminous flush coat material when the air temperature in the shade is 50 degrees F and rising and the pavement temperature is 70 degrees F and rising.
 - 2. Do not apply bituminous flush coat material during fog, rain, or other adverse conditions.

3.3 COVER MATERIAL STOCKPILE

- A. Construct on a clean base to minimize contamination.
- B. Construct individual 500 ton stockpiles of aggregates. Construct to facilitate uniform dampening. Avoid excess moisture.
 - 1. Engineer authorizes stockpiles at least one and a maximum of seven days before use.
 - 2. Combining, altering, or moving 500 ton stockpiles may require re-authorization by the Engineer before use.
- C. Notify the Engineer at least seven calendar days before placement in order for the initial stockpiles to be sampled and tested for acceptance.
- D. Obtain the Engineer's authorization of a stockpile before use.

- E. Rework or remove material not meeting specifications from the stockpile area. Identify stockpiles that will be reworked.
- F. The Engineer will retest corrected material for acceptance.

3.4 TEMPORARY PAVEMENT MARKINGS

- A. Apply raised pavement markers according to Section 01558.
- B. Apply temporary pavement marking paint according to Section 02765 as determined by the Engineer.

3.5 ASPHALT MATERIAL/COVER MATERIAL APPLICATION

- A. Apply asphalt material at a rate sufficient to obtain 50 percent chip embedment before the rolling operation and 70 percent chip embedment after rolling operation.
 - 1. Adjust application rates throughout the project depending on existing conditions.
- B. Apply the asphalt emulsion at a minimum temperature of 145 degrees F.
- C. Do not apply asphalt material if material does not spray through the distributor in a uniform way and remain in place on the roadway.
- D. Place building paper adjacent to the transverse construction joint before starting each spraying operation.
 - 1. Maintain the control valve to act instantaneously both at start-up and cut- off.
- E. Locate longitudinal joints within 6 inches of the traffic lane line location.
 - 1. Construct meet lines with no skip or voids between adjacent passes.
 - 2. Do not place a double thickness of cover material.
- F. Calibrate the spreader at the beginning of each day and as often as necessary to comply with Table 3.
 - 1. Maintain a distance of less than 150 ft between the distributor and the chip spreader.
 - 2. Maintain the chip spreader speed so that chips do not bounce or roll during application.

Table 3

	Approximate Spread Rates	
	Unit Weight lbs/ft ³	Application Rate lbs/yd ²
Lightweight Chip Seal	40-45	11.8
	45-50	12.5
	50-60	13.2
Chip Seal	60 – 65	17.0
	65 – 70	18.4
	70 -75	19.8
	75 – 80	20.7
	80 – 85	22.1
	85 – 90	23.5
	90 – 95	24.9
	95 – 100	25.8

3.6 SURFACE ROLLING

- A. Use at least three pneumatic-tire rollers in a longitudinal direction to roll surface after the cover material has been spread.
- B. Roll at least three passes to seat the cover material.
 1. A pass is defined as traveling in one direction only.
- C. Control bleeding with blotter material and as determined by the Engineer.
- D. Set the roller speed to prevent bouncing or skidding.
 1. Do not exceed 5 mph.
 2. Reduce roller speeds during directional changes to prevent surface tearing.
- E. Synchronize the speed of the distributor and chip spreader with that of the rolling operation.
 1. Begin initial rolling, consisting of one complete coverage, immediately behind the chip spreader.
 2. Begin secondary rolling, consisting of second and third coverage, immediately after completing initial rolling.
 3. Synchronize all operations to keep rolling operations within 2,500 feet of the ongoing chip seal application.
- F. Sweep excess cover material off the roadway after the emulsion has set.
 1. Remove excess cover material to the satisfaction of the Engineer before opening the roadway to traffic.
- G. Repair all damage to the seal coat before opening the roadway to traffic.

3.7 BITUMINOUS FLUSH COAT APPLICATION

- A. Clean the surface of all dirt, sand, dust, loose chips, and other objectionable material to the satisfaction of the Engineer before applying bituminous flush coat.
- B. Apply the bituminous flush coat at a rate of 0.11, $\pm$ 0.01 gal/yd².
 - 1. Keep traffic off the flushed surface until the bituminous material has set sufficiently to prevent tracking or pick-up.

3.8 TRAFFIC CONTROL

- A. Refer to Section 01554.

3.9 PAVEMENT MARKING PAINT

- A. Allow at least 7 calendar days after completing flush coat before applying permanent pavement markings. Refer to Section 02765.

END OF SECTION

SECTION 02786

OPEN-GRADED SURFACE COURSE (OGSC)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for constructing OGSC.

1.2 RELATED SECTIONS

- A. Section 02701: Pavement Smoothness
- B. Section 02745: Asphalt Material
- C. Section 02746: Hydrated Lime
- D. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

- A. AASHTO T 30: Mechanical Analysis of Extracted Aggregate
- B. AASHTO T 89: Determining the Liquid Limit of Soils
- C. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- D. AASHTO T 96: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- E. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- F. AASHTO T 112: Clay Lumps and Friable Particle in Aggregate
- G. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- H. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- I. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

- J. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- K. AASHTO T 308: Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method
- L. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- M. UDOT Materials Manual of Instruction
- N. UDOT Minimum Sampling and Testing Requirements
- O. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Job mix gradation for approval – at least 14 calendar days before paving.
 - 1. Materials and documentation according to Materials Manual of Instruction, Section 954.
 - 2. Aggregate suitability test results.
- B. Changes in Job Mix Gradation
 - 1. Written request for a change in a job-mix gradation for approval.
 - 2. Allow the Engineer five working days to review and approve the changes and to readjust the quantity of asphalt binder to be used.

1.6 ACCEPTANCE

- A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. A lot equals the number of tons placed during each production day.
 - 1. A lot is evaluated on the test results of four samples, with the following exceptions:
 - a. Compute incentive/disincentive using the test results from three samples if only three samples can be taken for the production day.
 - b. Add the lot to the next day's production if three random samples cannot be taken.
 - c. Add the lot to the previous day's production for the last day's production if three random samples cannot be taken.
 - d. The lot may be increased to include up to three production days when approved in advance by the Engineer and when less than 900 tons are anticipated per production day.

- e. Evaluate with the appropriate number of tests “n” in Table 4.
 2. Asphalt Binder – The Department will compute incentive/disincentive for asphalt binder content based on Table 1 using the single test result with the largest deviation from the target. Refer to AASHTO T 308.
 - a. Apply incentive to the entire lot.
 - b. Disincentive is applied only to the subplot defined as a percentage of the lot represented by the test.
 - c. Any lot that includes one or more sublots in disincentive is not eligible for incentive
 3. Gradation – The Department will compute incentive/disincentive for gradation based on Percent Within Limits computation using Tables 2, 3, 4, and 5. Refer to AASHTO T 30
 - a. The Department will reject the lot if the Percent Within Limits is less than 60 percent.
 4. Any lot rejected based on either gradation or asphalt binder content will not be eligible for any incentive.
- C. Thickness
1. Verify the thickness with a depth probe and take corrective action if necessary.
 - a. Minimum thickness – Plan depth minus $\frac{1}{4}$ inch.
- D. Smoothness
1. Determine acceptance and correct. Refer to Section 02701.
- E. Submit an engineering analysis within one week if requesting that a rejected lot or subplot remain in place.
1. Remove the rejected material from the project within 72 hours and replace it with an acceptable material if the request is denied.
 2. Agree on removal time period if rotomilling is required.
 3. Department deducts \$20/ton if a rejected lot or subplot is allowed to remain in place.

Table 1

Incentive/Disincentive for Binder Content	
Binder Content	Pay Adjustment in \$/ton OGSC
Within $\pm 0.30\%$ of target	1.00
Between $\pm 0.31\%$ and $\pm 0.45\%$ of target	0.00
Between $\pm 0.46\%$ $\pm 0.60\%$ of target	-2.00
Greater than $\pm 0.61\%$	Reject

Table 2

Gradation Upper and Lower Limit Determination	
Parameter	UL and LL
$\frac{3}{8}$ inch sieve	Target Value $\pm$ 6.0 percent
# 4 sieve	Target Value $\pm$ 6.0 percent
# 8 sieve	Target Value $\pm$ 5.0 percent
# 200 sieve	Target Value $\pm$ 2.0 percent

Table 3

Incentive/Disincentive for Gradation	
PT	Incentive/Disincentive (Dollars/Ton)
> 99	1.50
96-99	1.00
92-95	0.60
88-91	0.00
84-87	-0.26
80-83	-0.60
76-79	-0.93
72-75	-1.27
68-71	-1.60
64-67	-1.93
60-63	-2.27
<60	Reject

Table 4

Quality Index Values for Estimating Percent Within Limits										
PU/PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	N=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
<60	≤ 0.35	≤ 0.29	≤ 0.27	≤ 0.26	≤ 0.25	≤ 0.25	≤ 0.24	≤ 0.24	≤ 0.24	≤ 0.24

Enter table in the appropriate "number of tests" column and round down to the nearest value.

Table 5

Definitions, Abbreviations, and Formulas for Acceptance	
Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.
Sample Standard Deviations	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE divided by the number of test results minus one.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 2)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production. (Table 2)
Upper Quality Index (QU)	$QU = (UL - AVE)/s$
Lower Quality Index (QL)	$QL = (AVE - LL)/s$
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU.
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL.
Total Percentage of Lot (PL) Within UL and LL (PT)	$PT = (PU + PL) - 100$
Incentive/Disincentive	Determined by entering Table 3 with PT or PL.

All values for AVE, s, QU, and QL will be calculated to at least a two decimal places and will be carried through all further calculations. Rounding to lower accuracy is not allowed.

PART 2 PRODUCTS

2.1 ASPHALT BINDER

- A. Refer to Section 02745.
- B. Sampling procedure – UDOT Quality Management Plan - 509 Asphalt Binder.

2.2 HYDRATED LIME

- A. Refer to Section 02746.

2.3 AGGREGATE MATERIALS

- A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.

- B. Meet the following requirements, including Table 6.
1. Coarse aggregate
 - a. Retained on # No. 4 sieve.
 2. Fine aggregate
 - a. Clean, hard grained, and angular.
 - b. Passing the # No. 4 sieve.

Table 6

Aggregate Properties		
Properties	Test Method	Test Requirement
One Fractured Face	AASHTO T 335	95 percent min.
Two Fractured Face	AASHTO T 335	90 percent min.
Fine Aggregate Angularity	AASHTO T 304	45 min.
L.A. Wear	AASHTO T 96	30% max.
Sand Equivalent	AASHTO T 176	60 min.
Plasticity Index	AASHTO T 89 and T 90	0
Polish Test	AASHTO T 278 & T 279	31 min.
Soundness (sodium sulfate)	AASHTO T 104	12% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max.
Natural Fines	None	None

2.4 JOB MIX

- A. Obtain Engineer's review for job mix gradation.
1. Show definite single values for the percentage of aggregate passing each sieve based on the dry weight of aggregate.
 2. Stay within the single value gradation limits of Table 7.
 3. Incorporate minimum hydrated lime by dry weight of aggregate into all mixtures. Refer to Section 02746
 - a. Method A, Lime Slurry incorporate 1 percent
 - b. Method B, Lime Slurry Marination incorporate 1½ percent
- B. Binder Content
1. The Engineer determines the binder content.

Table 7

Aggregate Gradation	
Percent Passing by Dry Weight of Aggregate	
Sieve Size	Percent
½ inch	100
¾ inch	90 - 100
# 4	35 - 45
# 8	14 - 20
# 200	2 - 4

PART 3 EXECUTION

3.1 MIXING

- A. Mix until all particles are coated with the asphalt binder.
- B. Treat aggregate with hydrated lime. Refer to Section 02746.

3.2 SURFACE PLACEMENT

- A. Apply the tack coat at a uniform rate. Refer to Section 02748.
- B. Maintain a steady paver speed.
- C. Roll sufficiently to seat without fracturing aggregate.
- D. Bring all passes up even transversely at the end of each working day.
- E. Construct longitudinal joints within 6 inches of lane lines.
- F. Remove slick spots as determined by the Engineer.

3.3 LIMITATIONS

- A. Place between May 1 and September 15.
 - 1. Obtain authorization from the Engineer before placing OGSC after September 15.
- B. Place when the air temperature in the shade and the pavement surface temperature are above 60 degrees F and rising.
- C. Do not place if surface moisture is present.
- D. Do not place during rain or other adverse weather conditions.

END OF SECTION

SECTION 02787

BONDED WEARING COURSE (BWC)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for the placement of a Bonded Wearing Course (BWC) and associated Polymer-Modified Emulsion Membrane.

1.2 RELATED SECTIONS

- A. Section 01456: Materials Dispute Resolution
- B. Section 02701: Pavement Smoothness
- C. Section 02741: Hot Mix Asphalt (HMA)
- D. Section 02742S: Project Specific Surfacing Requirements
- E. Section 02745: Asphalt Material
- F. Section 02746: Hydrated Lime

1.3 REFERENCES

- A. AASHTO T 11: Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- C. AASHTO T 44: Solubility of Bituminous Materials
- D. AASHTO T 49: Penetration of Bituminous Materials
- E. AASHTO T 59: Emulsified Asphalt
- F. AASHTO T 89: Determining the Liquid Limit of Soils
- G. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils
- H. AASHTO T 96: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact the Los Angeles Machine

- I. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- J. AASHTO T 112: Clay Lumps and Friable Particle in Aggregate
- K. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- L. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- M. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel
- N. AASHTO T 283: Resistance of Compacted Asphalt Mixture to Moisture Induced Damage
- O. AASHTO T 301: Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
- P. AASHTO T 304: Uncompacted Void Content of Fine Aggregate
- Q. AASHTO T 305: Determination of Drain down Characteristics in Uncompacted Asphalt Mixtures
- R. AASHTO T 312: Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
- S. AASHTO T 327: Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- T. AASHTO T 330: The Qualitative Detection of Harmful Clays of the Smectite Group in Aggregates Using Methylene Blue Aggregates
- U. AASHTO T 335: Determining the Percentage of Fracture in Coarse Aggregate
- V. ASTM D 2995: Estimating Application Rate and Residual Application Rate of Bituminous Distributors
- W. Asphalt Institute Standards
- X. UDOT Materials Manual of Instruction
- Y. UDOT Minimum Sampling and Testing Requirements

Z. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Bonded Wearing Course (BWC) – A spray-paver applied surface treatment consisting of a warm Polymer-Modified Emulsion Membrane and an ultra-thin, gap-graded hot mix asphalt overlay. It is typically less than 1 inch thick. The hot mix asphalt surface course is placed immediately on the emulsion. A BWC is a homogeneous wearing surface and pavement seal that can be opened to traffic immediately after cooling.
- B. Polymer-Modified Emulsion Membrane (PMEM) – A warm, modified emulsion applied to the pavement to seal the underlying pavement and provide a strong bond to the surface course.
- C. Production Day – A 24 hour period in which BWC is being placed.

1.5 SUBMITTALS

- A. Mix design data to the Engineer for review at least 14 calendar days before paving. Do not pave until mix design is authorized for use.
 - 1. Include all information on selection of design aggregate structure showing the target values of percent passing on all sieves listed in Table 9.
 - 2. Indicate the design asphalt binder content and the estimated asphalt binder film thickness.
 - 3. Provide test results verifying that proposed aggregate meets the requirements of Table 8.
 - 4. Indicate the target job mix gradation and supply QC data for the target selection.
 - a. Use these target values for price adjustments.
- B. Lottman test data using Method A lime slurry for all sources. Refer to this Section, Article 2.5.
 - 1. Submit both A and B lime slurry data for new sources having no historic data.
 - 2. Meet minimum Tensile Strength Ratio (TSR) of 80 percent.
- C. Draindown test results using AASHTO T 305.
- D. Joint layout plan to the Engineer for review at least 10 calendar days before placement.

- E. Daily totals – Refer to this Section, Article 3.6, paragraph Q.
 - 1. Clearly show placement of the longitudinal joints with respect to final pavement markings and meeting the requirements of this Section, Article 3.6, paragraph I.

1.6 ACCEPTANCE

- A. Acceptance sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. A lot equals the number of square yards placed during each production day.
 - 1. The lot may be increased to include up to three production days approved when daily production rates are anticipated to be less than 15,000 yd².
- C. Incentive / Disincentive for Asphalt Binder Content and Gradation
 - 1. The Engineer evaluates a lot on the test results of four samples with the following exceptions:
 - a. Compute Incentive/Disincentive using the test results from three samples if only three samples can be taken for the production day.
 - b. Combine test results with the next day of production if at least three random samples cannot be taken. Take one sample for each 15,000 yd², or portion thereof, from the following day's production. Evaluate with the appropriate number of tests "n" in Table 4.
 - c. Add the lot to the previous day's production for the final day's production if three random samples cannot be taken.
 - d. Evaluate with the appropriate number of tests "n" in Table 4.
 - 2. The Engineer informs the Contractor of the time and place of sampling not more than 15 minutes before the sampling.
 - a. Samples taken will be sufficiently large to allow for repeat testing according to Section 01456.
 - b. Retained material for repeat testing will be immediately stored by the Engineer until the represented lots are accepted.
 - 3. Compute Incentive/Disincentive for binder content per lot based on Table 1 using the single test result with the largest deviation from the target.
 - 4. Incentive/Disincentive for gradation is based on Percent within Limits (PT) computation using Table 2, 3, 4, and 5.
 - 5. The Department will reject the lot if the PT is less than 60 percent.
 - 6. Any lot rejected based on gradation or binder content will not be eligible for any incentive.

- D. Reject Material
1. Remove the rejected material from the project within 72 hours and replace it with an acceptable material if the request is denied.
 2. Agree on removal time period if rotomilling is required.
 3. Department will deduct 40 percent of the bid price if a rejected lot is allowed to remain in place.
- E. Thickness
1. Verify the thickness with a depth probe and take corrective action if necessary.
 - a. Minimum thickness – Plan depth
- F. Acceptance / Disincentive for Polymer Modified Emulsion Membrane (PMEM) application rate
1. Verify the application rate of the PMEM for each lot and apply pay adjustment based on Table 6.
 - a. A lot equals the number of square yards placed during each production day.
 - b. Use the weight of PMEM provided on the weight ticket to convert from tons to gallons.

Table 1

Incentive/Disincentive	
Binder Content	Pay Adjustment (dollars per yd ² of BWC)
Within ± 0.30% of target	0.05
Between ± 0.31% and ± 0.45% of target	0.00
Between ± 0.46% ± 0.60% of target	-0.10
Greater than ± 0.61%	Reject

Table 2

Gradation Upper and Lower Limit Determination	
Parameter	UL and LL
½ inch sieve for BWC Type C ¾ inch sieve for BWC Type B	Target Value ± 6.0 percent
# 4 sieve	Target Value ± 6.0 percent
# 8 sieve	Target Value ± 5.0 percent
# 50 sieve	Target Value ± 3.0 percent
# 200 sieve	Target Value ± 2.0 percent

Table 3

Incentive/Disincentive for Gradation	
PT Based on Min. Four Samples	Pay Adjustment (dollars per yd² of BWC)
> 99	0.06
96-99	0.04
92-95	0.02
88-91	0.00
84-87	-0.01
80-83	-0.02
76-79	-0.04
72-75	-0.05
68-71	-0.06
64-67	-0.07
60-63	-0.09
<60	Reject

Table 4

Quality Index Values (QU or QL) for Estimating Percent Within Limits										
PU or PL	n=3	n=4	n=5	n=6	n=7	n=8	n=10	n=12	n=15	n=20
100	1.16	1.50	1.75	1.91	2.06	2.15	2.29	2.35	2.47	2.56
99	1.16	1.47	1.68	1.79	1.89	1.95	2.04	2.09	2.14	2.19
98	1.15	1.44	1.61	1.70	1.77	1.80	1.86	1.89	1.93	1.97
97	1.15	1.41	1.55	1.62	1.67	1.69	1.74	1.77	1.80	1.82
96	1.15	1.38	1.49	1.55	1.59	1.61	1.64	1.66	1.69	1.70
95	1.14	1.35	1.45	1.49	1.52	1.54	1.56	1.57	1.59	1.61
94	1.13	1.32	1.40	1.44	1.46	1.47	1.49	1.50	1.51	1.53
93	1.12	1.29	1.36	1.38	1.40	1.41	1.43	1.43	1.44	1.46
92	1.11	1.26	1.31	1.33	1.35	1.36	1.37	1.37	1.38	1.39
91	1.10	1.23	1.27	1.29	1.30	1.31	1.32	1.32	1.32	1.33
90	1.09	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27
89	1.08	1.17	1.20	1.21	1.21	1.21	1.21	1.21	1.22	1.22
88	1.07	1.14	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.13	1.13	1.13	1.13	1.13
86	1.05	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.05	1.05	1.04	1.04	1.04	1.04	1.04
84	1.02	1.02	1.02	1.01	1.01	1.01	1.00	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
82	0.98	0.96	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.92
81	0.96	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88
80	0.94	0.90	0.88	0.87	0.86	0.86	0.85	0.85	0.85	0.85
79	0.92	0.87	0.85	0.84	0.83	0.83	0.82	0.82	0.82	0.81
78	0.89	0.84	0.82	0.81	0.80	0.79	0.79	0.78	0.78	0.78
77	0.87	0.81	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.75
76	0.84	0.78	0.76	0.75	0.74	0.73	0.72	0.72	0.72	0.72
75	0.82	0.75	0.73	0.72	0.71	0.70	0.69	0.69	0.69	0.68
74	0.79	0.72	0.70	0.68	0.67	0.67	0.66	0.66	0.66	0.65
73	0.77	0.69	0.67	0.65	0.64	0.64	0.62	0.62	0.62	0.62
72	0.74	0.66	0.64	0.62	0.61	0.61	0.60	0.59	0.59	0.59
71	0.71	0.63	0.60	0.59	0.58	0.58	0.57	0.56	0.56	0.56
70	0.68	0.60	0.58	0.56	0.55	0.55	0.54	0.54	0.54	0.53
69	0.65	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.50
68	0.62	0.54	0.52	0.51	0.50	0.50	0.48	0.48	0.48	0.48
67	0.59	0.51	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45
66	0.56	0.48	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42
65	0.53	0.45	0.43	0.42	0.41	0.41	0.40	0.40	0.40	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34
62	0.43	0.36	0.34	0.33	0.33	0.33	0.32	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.28
60	0.36	0.30	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.25
<60	≤0.35	≤0.29	≤0.27	≤0.26	≤0.25	≤0.25	≤0.24	≤0.24	≤0.24	≤0.24

Enter table in the appropriate sample size column and round down to the nearest value.

Table 5

Definitions, Abbreviations, and Formulas for Acceptance	
Term	Explanation
Target Value (TV)	The target values for gradation and asphalt binder content are given in the Contractor's volumetric mix design.
Average (AVE)	The sum of the lot's test results for a measured characteristic divided by the number of test results, the arithmetic mean.
Standard Deviation (s)	The square root of the value formed by summing the squared difference between the individual test results of a measured characteristic and AVE divided by the number of test results minus one. This statement does not limit the methods of calculations of s. Other methods that obtain the same value may be used.
Upper Limit (UL)	The value above the TV of each measured characteristic that defines the upper limit of acceptable production. (Table 2)
Lower Limit (LL)	The value below the TV of each measured characteristic that defines the lower limit of acceptable production (Table 2)
Upper Quality Index (QU)	$QU = (UL - AVE)/s$
Lower Quality Index (QL)	$QL = (AVE - LL)/s$
Percentage of Lot Within UL (PU)	Determined by entering Table 4 with QU
Percentage of Lot Within LL (PL)	Determined by entering Table 4 with QL
Total Percentage of Lot (PL) Within UL and LL (PT)	$PT = (PU + PL) - 100$
Incentive/Disincentive	Determined by entering Table 1 and 3 with PT or PL.

Calculate all values for AVE, s, QU, and QL to two decimal place accuracy and carried through all further calculations. Rounding to lower accuracy is not allowed.

Table 6

PMEM Pay Adjustment	
Actual Field PMEM Rate (Gallons/Square Yard)	Pay Adjustment (dollars per yd² of BWC)
Within Specified Rate ± 0.03	0
Within Specified Rate ± 0.03 to ± 0.06	-2.00
Not Within Specified Rate ± 0.06	Remove and Replace

PART 2 PRODUCTS

2.1 ASPHALT BINDER

- A. Project Specific Surfacing Requirements. Refer to Special Provision 02742S.
- B. Refer to Section 02745.

2.2 POLYMER MODIFIED EMULSION MEMBRANE (PMEM)

- A. Project Specific Surfacing Requirements. Refer to Special Provision 02742S.
- B. Refer to Section 02745.
- C. Supply PMEM from a pre-qualified supplier under the provisions outlined in UDOT Quality Management Plan 508, Asphalt Emulsion.
- D. Meet the requirements of Table 7.

Table 7

Polymer Modified Emulsion Membrane (a)			
Tests	AASHTO Test Method	Min.	Max.
Emulsion			
Viscosity, SFS, 122° F (50° C), sec	T 59	20	100
Storage Stability Test, 1 d, 24 h, percent	T 59		1
Sieve Test (b), percent	T 59		0.1
Demulsibility, % 35 ml 0.8% sodium dioctyl sulfosuccinate	T 59	40	
Distillation			
Oil Distillate, by volume of emulsion, percent			2
Residue (c), percent		63	
Residue from Distillation Test			
Penetration, 77° F (25° C), 100 g, 5s, dmm	T 49	60	150
Elastic Recovery (d), percent	T 301	55	
Solubility			
Solubility in Organic Solvent, percent	T 44	97.5	
(a) The emulsion will be smooth and homogeneous throughout with no white, milky separation, pumpable and suitable for application through spray bars after standing undisturbed for 24 hours. Modify before emulsification. (b) The sieve test may be waived if successful application of the material has been achieved in the field. (c) Distillation is determined by AASHTO T 59 with modifications to include a $350 \pm 5^\circ \text{F}$ ($177 \pm 3^\circ \text{C}$) maximum temperature to be held for a period of 15 minutes. (d) Modify paragraph 4.5 of AASHTO T 301 as follows: Stop the ductilometer and within two seconds, sever the specimen at its center with a pair of scissors after 20 cm has been reached.			

2.3 HYDRATED LIME

- A. Refer to Section 02746.

2.4 AGGREGATE MATERIALS

- A. Crusher processed virgin aggregate material consisting of crushed stone, gravel, or slag.
- B. Determine the suitability of the aggregate according to Table 8.
1. Coarse aggregate
 - a. Retained on # 4 sieve
 2. Fine aggregate
 - a. Clean, hard grained, and angular
 - b. Passing the # 4 sieve

Table 8

Bonded Wearing Course (BWC)
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Aggregate Properties		
Properties	Test Method	Test Requirement
One Fractured Face	AASHTO T 335	95% min.
Two Fractured Face	AASHTO T 335	90% min.
Fine Aggregate Angularity	AASHTO T 304	45% min.
Flakiness Index	UDOT MOI 933 (Based on $\frac{3}{8}$ inch sieve and above)	17% max.
L.A. Wear	AASHTO T 96	30% max.
Micro-Deval Loss	AASHTO T 327	18% max. loss
Sand Equivalent	AASHTO T 176	60 min.
Plasticity Index	AASHTO T 89 and T 90	0
Polish Test	AASHTO T 278 and T 279	31 min.
Soundness (sodium sulfate)	AASHTO T 104	12% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max.
Natural Fines	None	None
Methylene Blue	AASHTO T 330	10% max.

C. Meet gradation requirements in Table 9.

Table 9

Aggregate Gradation Percent Passing by Dry Weight of Aggregate AASHTO T 11, T 27			
Sieve Size	Percent		
	Type A	Type B	Type C
$\frac{3}{4}$ inch	100	100	100
$\frac{1}{2}$ inch	100	100	75 - 100
$\frac{3}{8}$ inch	100	75 - 100	55 - 80
# 4	40 - 55	22 - 38	22 - 38
# 8	22 - 32	19 - 32	19 - 32
#16	15 - 25	15 - 25	15 - 25
#30	10 - 18	10 - 18	10 - 18
#50	8 - 13	8 - 13	8 - 13
#100	6 - 10	6 - 10	6 - 10
# 200	4 - 7	4 - 7	4 - 7

2.5 JOB MIX DESIGN

- A. Meet the following requirements:
 - 1. Establish optimum binder content, minimum 5.0 percent by weight of mixture, corresponding to an estimated asphalt film thickness of at least 10 microns based on effective binder content and aggregate surface area calculated according to Asphalt Institute MS-2 Table 6.1.
 - 2. Verify draindown at optimum binder content is less than 0.10 percent when tested according to AASHTO T 305.
 - 3. Moisture susceptibility (Lottman), AASHTO T 283, with the following modifications:
 - a. Compact samples according to AASHTO T 312 using a 4 inch diameter mold and 30 gyrations.
 - b. Use mix quantity necessary to obtain compacted samples 2.5 ± 0.05 inch high.
 - c. Further test compacted samples regardless of air void levels achieved after 30 gyrations.
 - d. Apply vacuum to samples to be conditioned for 1 minute and proceed without calculating percent saturation.
 - 4. Use a laboratory accredited by AASHTO Materials Reference Laboratory (AMRL) for all testing.
- B. Use a pre-qualified asphalt binder supplier.
- C. Use a pre-qualified PMEM supplier.
- D. Use mixing and compaction temperatures supplied by the Engineer.
- E. The Department's Region Materials Lab will verify the Mix Design.

PART 3 EXECUTION

3.1 PRE-PAVING MEETING

- A. Arrange for Contractor's supervisory personnel, crew, and the testing laboratory personnel to meet with a representative of the Department at a mutually agreed time within two weeks before starting the BWC process to discuss methods of accomplishing all phases of the work.
 - 1. Arrange for a representative of the mix design and emulsion supplier to be present.

3.2 MIXING

- A. Mix as specified in Section 02741.
 - 1. The mineral aggregate coating will be considered satisfactory when all particles are coated.

3.3 PAVER CHARACTERISTICS

- A. Use a self-priming paver designed and built for applying the BWC and authorized by the Engineer with the following characteristics:
 - 1. Equipped with a receiving hopper, asphalt emulsion storage tank, system for measuring the PMEM volume applied, spray bar, and a heated, variable-width screed.
 - 2. Capable of spraying the PMEM, applying the hot mix asphalt overlay, and leveling the surface of the mat in one pass.
 - 3. Capable of placing the hot mix asphalt within five seconds after the application of the PMEM.
 - 4. Capable of paving at a controlled speed from 30 to 90 feet per minute.
 - a. Make no contact between the wheel or other part of the paving machine and the PMEM before applying the hot mix asphalt.
- B. Use a paver with a screed that is able to crown the pavement at the center and have vertically adjusted extensions to accommodate the desired pavement profile.

3.4 MATERIAL TRANSFER VEHICLE CHARACTERISTICS

- A. Use Material Transfer Vehicle (MTV) authorized by the Engineer with the following characteristics:
 - 1. Able to remix the BWC to eliminate truck end segregation, minimize temperature segregation, and deliver a uniform BWC to the paver.
 - 2. Self-propelled machine totally independent of the paver.
 - 3. High capacity truck unloading system to receive BWC from the haul units.
 - 4. Minimum 25 ton on-board BWC surge capacity to minimize paver start/stops and maximize trucking efficiency.
 - 5. Equipped with a pivoting paver loading conveyor.
 - a. Able to swing to either side to allow off-lane paving.
 - 6. Paver hopper
 - a. Equipped with a hopper insert with a minimum capacity of 7 tons.
 - b. Hopper insert with mass flow design to deliver remixed BWC directly to the paver conveyor system.

- B. Deposit the BWC material directly from haul trucks into the MTV without contacting the pavement.

3.5 SURFACE PREPARATION

- A. Protect and cover manhole covers, drains, grates, catch basins, and other utility structures with plastic or building felt before paving.
 - 1. Clearly reference each location.
- B. Remove thermoplastic traffic markings.
- C. Remove symbols, characters, or other markings greater than ¼ inch above the existing pavement.
- D. Allow at least two weeks for any crack sealant to cure before placing BWC.
- E. Thoroughly clean the pavement surface to be overlaid of deleterious material, giving specific attention to accumulated mud and debris.
 - 1. Use pressurized water or vacuum systems, if necessary, to obtain a clean surface.

3.6 BWC PLACEMENT

- A. Provide a clean surface before and during paving operations.
 - 1. Immediately remove any loose material in front of the paver.
- B. Spray the PMEM with a metered mechanical pressure spray bar at a temperature of 120 to 180 degrees F at the specified application rate.
 - 1. Overlap the vertical edge with the outside nozzle 0.5 to 1.5 inches when paving next to a vertical edge to guarantee proper application of the PMEM.
 - 2. Verify the application of the PMEM is uniform over the entire surface to be paved.
- C. Calibrate the Spray Paver for application of PMEM according to ASTM D 2995 or an approved method by the Engineer before start of BWC production.
 - 1. Recalibrate Spray Paver before the startup of nonconsecutive placements of BWC material.
 - 2. Calibrate machine at 13 ft width and 17 ft width.
 - a. Verify spread rates for right and left sides are uniform, meet the specified application rates, and do not vary more than 20 percent between right and left side pads.

3. Calibrate the machine on-site or within BWC mix haul distance and in the presence of the Engineer.
4. Maintain a copy of the manufacturer application settings with the spray paving equipment.
 - a. Include the nozzle size and target shot rate settings.
- D. Apply hot BWC at a temperature of 290 to 330 degrees F immediately over the PMEM application.
- E. Place hot BWC over the full width of the PMEM with a heated screed.
- F. Maintain a steady spray-paver speed.
- G. Roll BWC material sufficiently to seat without fracturing mix aggregate.
- H. Use steel-wheeled, 2-axle tandem rollers, each weighing at least 10 tons.
 1. Use well-maintained rollers equipped with functioning water system and scrapers to prevent adhesion of the fresh mix onto the roller drums.
 2. Supply adequate roller units to guarantee the rolling will be accomplished promptly following the placement of the material.
 3. Use a release agent (added to the water system) as needed to prevent adhesion of the fresh mix to the roller drum and wheels.
 4. Use static mode for rolling.
 5. Do not allow the rollers to remain stationary on the freshly placed material.
- I. Construct longitudinal joints within 6 inches of lane lines or at the center of lane, but never in a wheel path.
- J. Construct a transverse joint when the paving operation stops for more than 30 minutes.
- K. Do not overlap or hot-lap BWC.
- L. Pave through lanes after paving adjacent:
 1. Shoulders
 2. Tapers
 3. Transitions
 4. Road connections
 5. Private drives
 6. Curve widenings
 7. Chain control lanes
 8. Turnouts
 9. Left turn pockets
 10. Median borders

- 11. On and off ramps
- M. Verify all edges of adjacent areas to through lanes that have been paved with BWC have straight, uniform, longitudinal lines, and neat vertical edges to guarantee surface is neat in appearance after through lanes are paved.
- N. Do not reintroduce previously applied BWC into the paving process over PMEM.
- O. Stop paving and remove and dispose of the contaminated material if PMEM is spilled into the spray-paver hopper.
- P. Meet the requirements of Section 02701 for smoothness.
- Q. Report daily totals of placement materials to the Engineer and include the following:
 - 1. Tonnage of BWC material placed with weight tickets
 - 2. Gallons of PMEM applied with weight tickets
 - 3. Square yards for the production day
 - 4. Gallons per square yard of PMEM placed
 - 5. Pounds per square yard of BWC material placed

3.7 LIMITATIONS

- A. Place between May 1, and September 15, when both the air temperature in the shade and the pavement surface temperature are above 60 degrees F and rising.
- B. Do not place if the Engineer determines excessive moisture is present in the pavement structure.
- C. Do not place during rain, when the surface is wet, or during other adverse weather conditions.
- D. Do not open the new pavement to traffic until the rolling operation is complete and the material has cooled below 185 degrees F.

3.8 LABORATORY CORRELATION

- A. Perform split-sample, paired t-testing with the Department based on project quality control testing using Department LQP qualified lab.
 - 1. Perform split-sample, paired t analysis on all mix acceptance tests and tests related to volumetric properties.
 - 2. Perform paired t-analysis as defined in the UDOT Materials Manual of Instruction, Appendix C.

3. Continue paired t-testing until at least two consecutive production days meet $\alpha = 0.05$ for a two tailed distribution.
4. Resolve discrepancies in lab results within the first five production days.
 - a. Cease production if the requirements for two consecutive days of the first five days cannot be met.
 - b. Submit a corrective action plan to the Engineer before production continues indicating the changes in procedures that will be implemented to correct the deficiencies.
 - 1) Both Contractor and Department labs must make paired t test results available within 24 hours of sampling.

3.9 DISPUTE RESOLUTION

- A. Refer to Section 01456 when disputing the validity of the Department's acceptance tests.
- B. The option to dispute the validity of the Department's test results is waived if the paired t-testing is not performed. Refer to this Section, Article 3.8.

END OF SECTION

SECTION 02789

ASPHALT SLURRY SEAL COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products and procedures for mixing and spreading a properly proportioned mixture of fine graded aggregate, mineral filler, emulsified asphalt, and water.
- B. Products and procedures for cured slurry with a homogeneous appearance, firm surface adhesion, and skid resistant texture.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 17: Mineral Filler for Bituminous Paving Mixtures
- B. AASHTO M 29: Fine Aggregate for Bituminous Paving Mixtures
- C. AASHTO M 208: Cationic Emulsified Asphalt
- D. AASHTO T 11: Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregate
- E. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates
- F. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- H. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- I. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester
- J. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

- K. ISSA A105 Guidelines
- L. UDOT Quality Management Plan
- M. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Mix Design and test results to the Engineer 10 days before beginning construction.
 - 1. Meet the requirements of this Section, Article 2.7.
 - 2. Include target gradation for combined aggregate and mineral filler.
- B. Test reports for aggregate.
 - 1. Meet the requirements of this Section, Article 2.2.
- C. Manufacturer's Certificate of Compliance for Mineral Filler.
- D. Verification that the emulsified asphalt supplier adheres to UDOT Quality Management Plan 508 Asphalt Emulsion.
 - 1. Certificate of analysis/compliance from the manufacturer for each shipment.

1.6 ACCEPTANCE

- A. Sampling and testing of material is according to UDOT Minimum Sampling and Testing Requirements.
- B. Meet the Target Tolerance of Table 1.

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

- A. Use a cationic emulsified asphalt grade CQS-1h according to AASHTO M 208.
- B. Verify that the shipment is the same as the mix design.
- C. Refer to UDOT Quality Management Plan 508 Asphalt Emulsion.

2.2 AGGREGATE

- A. Use 100 percent manufactured sand, slag, crushed fines, or a combination. Refer to AASHTO M 29.
- B. Use aggregate that is clean and free from organic matter or other detrimental substances.
- C. Use an aggregate blend with a sand equivalent of 45 or more. Refer to AASHTO T 176.
- D. Meet a minimum polishing value of 31. Refer to AASHTO T 278 and AASHTO T 279.
- E. Use aggregate with 35 percent or less loss by abrasion. Refer to AASHTO T 96.
- F. Meet 15 percent soundness maximum using Na₂ SO₄. Refer to AASHTO T 104.

2.3 MINERAL FILLER

- A. Use Portland Cement, hydrated lime, or aluminum sulfate. Refer to AASHTO M 17.

2.4 COMBINED AGGREGATE AND MINERAL FILLER

- A. Use a job mix or target gradation within the gradation band. Base the mix design on this gradation. The percent passing each sieve after the target gradation has been submitted will not vary by more than the target tolerance and still remain within the gradation band in Table 1. Refer to AASHTO T 11 and AASHTO T 27.

Table 1

Gradation		
Sieve Size	Gradation Band (% Passing)	Target Tolerance
3/8 inch	100	
No. 4	70-90	+/- 5%
No. 8	45-70	+/- 5%
No. 16	28-50	+/- 5%
No. 30	19-34	+/- 5%
No. 50	12-28	+/- 4%
No. 100	7-18	+/- 3%
No. 200	5-15	+/- 2%

2.5 WATER

- A. Potable and free from harmful salts and contaminants.

2.6 ADDITIVES

- A. Use additives as required to accelerate or retard the break-set of the slurry seal or to improve the resulting finished surface.
1. Determine the initial additive quantities by the mix design for the slurry mix or individual materials.
 2. Obtain Engineer approval.

2.7 SLURRY SEAL MIX DESIGN

- A. Use a Department approved laboratory conforming to the ISSA A105 tested listed in Table 2.
1. Use the same materials and aggregate gradation to be used on the project.

Table 2

TESTS		
ISSA TEST NO.	DESCRIPTION	SPECIFICATION
ISSA TB 106	Slurry Seal Consistency	2cm Minimum 3cm Maximum
ISSA TB-139 For quick-traffic systems	Wet Cohesion 30 Minutes Minimum (Set) Wet Cohesion 60 Minutes Minimum	12 kg-cm Minimum 20 kg-cm Minimum
ISSA TB 109 For heavy-traffic areas only	Excess Asphalt by LWT Sand Abrasion	50 g/ft ² Maximum (538 g/m ² Maximum)
ISSA TB-114	Wet Stripping	Pass (90% Minimum)
ISSA TB-100	Wet-Track Abrasion Loss, One-hour Soak	75 g/ft ² (807 g/m ²)
ISSA TB-113	Mix Time**	Controllable to 180 Seconds Minimum

** Perform the mixing test and set-time test at the highest temperatures expected during construction.

2.8 EQUIPMENT

- A. Use only a machine designed and manufactured specifically for blending, mixing, and placing slurry seal.
 - 1. Mix the material in a self-propelled, slurry seal mixing machine of either truck-mounted or continuous-run design.
 - a) Continuous-run machines – Equipped to self-load materials while continuing to lay slurry seal.
 - b) Either type machine – Accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving mixer and to discharge the mixed product on a continuous-flow basis.
 - 2. Maintain sufficient storage capacity within the machine for aggregate, emulsified asphalt, mineral filler, control additive, and water to maintain an adequate supply to the proportioning controls.
- B. Calibrate each mixing unit in the presence of the Engineer before a machine is used on a project

PART 3 EXECUTION

3.1 LIMITATIONS

- A. Do not apply slurry seal during rain, when road surface moisture is present, or during other adverse weather conditions.
- B. Do not apply slurry seal if either the pavement or air temperature is below 50 degrees F and falling.
 - 1. Slurry seal may be applied when both the pavement and air temperatures are above 45 degrees F and rising.
- C. Do not apply slurry seal when the temperature is projected below 33 degrees F within 24 hours of placing slurry seal.
- D. Cease slurry seal operations when weather or other conditions prolong opening road surface to traffic beyond two hours.
- E. Keep traffic off roadway surface until the slurry seal has cured.

3.2 STOCKPILE

- A. Construct individual 500-ton stockpiles of slurry seal aggregates.
 - 1. Engineer approves stockpiles at least one and at most seven days before use.

- B. Notify the Engineer at least seven calendar days before slurry seal placement in order for the initial stockpiles to be sampled and tested for acceptance.
- C. Obtain the Engineer's written acceptance of all stockpiles before use in slurry seal.
- D. Remove material not meeting specifications from the stockpile area.
- E. The Department will retest corrected material for acceptance.

3.3 PREPARATION

- A. Clean the surface of all dirt, sand, dust, oil, and other objectionable material immediately before applying the slurry.
- B. Allow cracks to dry thoroughly before applying slurry seal when using water to clean the surface.
- C. Protect manholes, valve boxes, drop inlets, and other service utility entrances before surfacing.

3.4 APPLICATION

- A. Pre-wet the entire surface by fogging ahead of the slurry box.
 - 1. Do not over apply, causing free water to sit on the pavement in front of the slurry box.
- B. Carry a sufficient amount of slurry in all parts of the spreader at all times so that full width and complete coverage is obtained with no streaks or narrow spots.
 - 1. Avoid overloading the spreader.
- C. Apply slurry mixture of proper consistency at an average rate of 18 to 22 lb/yd² of dry aggregate.
- D. Do not add additional water for any reason, once the mixture has been placed onto the road surface.
- E. Remove and replace the slurry if any of the following occurs:
 - 1. Lumping, balling, or unmixed aggregates.
 - 2. Separation of the coarse aggregate from the emulsion and fines.
 - 3. Settling of the coarse aggregate to the bottom of the mix.
 - 4. Excessive breaking of emulsion inside the spreader box.
 - 5. Streaking caused by oversized aggregate.

3.5 FINISHING DETAILS

- A. Do not create build-up when constructing longitudinal and transverse joints.
- B. Place slurry seal adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge.
 - 1. Do not allow over-lap on these areas.
 - 2. Remove slurry seal placed on concrete.
- C. Maintain straight lines at all locations.
- D. Place slurry seal at side streets and intersections out to right-of-way line.
- E. Use hand squeegees to spread slurry in areas that cannot be reached with slurry seal machine.
 - 1. Lightly dampen areas before mix placement.
 - 2. Provide complete and uniform coverage.
 - 3. Avoid unsightly appearance from hand work.
 - 4. Use the same type of finish in hand worked areas as applied by the spreader box.
- F. Use construction paper or comparable products so all beginning and ending joint lines from each construction pass are straight.

END OF SECTION

SECTION 02821

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chain link fencing and gates.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 181: Chain Link Fence
- C. AASHTO M 232: Zinc Coating (Hot Dip) on Iron and Steel Hardware
- D. AASHTO M 270: Structural Steel for Bridges
- E. AASHTO M 280: Zinc-Coated (Galvanized) Steel Barbed Wire
- F. ASTM A 121: Metallic-Coated Carbon Steel Barbed Wire
- G. ASTM A 194: Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- H. ASTM A 392: Zinc-Coated Steel Chain-Link Fence Fabric
- I. ASTM F 436: Hardened Steel Washers
- J. ASTM A 491: Aluminum-Coated Steel Chain-Link Fence Fabric
- K. ASTM A 563: Carbon and Alloy Steel Nuts
- L. ASTM F 668: Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric
- M. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

- N. ASTM F 1043: Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- O. ASTM F 1083: Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- P. ASTM F 1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- Q. AWS D1.1 Structural Welding Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 GENERAL

- A. Concrete
 - 1. Class B Concrete – Refer to Section 03055.
- B. Non-shrink Grout
 - 1. Refer to ASTM C 1107.
- C. Anchor Bolt Assembly
 - 1. Anchor Bolts – Refer to ASTM F 1554.
 - 2. Nuts – Refer to ASTM A 563 or ASTM 194.
 - 3. Washers – Refer to ASTM F 436.
- D. Base Plate
 - 1. AASHTO M 270, Grade 36.
 - 2. Weld post to base plate according to AWS D1.1.
 - 3. Galvanize after fabrication according to AASHTO M 111.

2.2 POSTS, CAPS, RAILS, AND COUPLINGS

- A. Pipe Posts and Rails
 - 1. Schedule 40, hot-dip galvanized coated pipe.
 - a. Refer to ASTM F 1043 and ASTM F 1083.
- B. Fittings
 - 1. Malleable cast iron or pressed steel coated.
 - a. Refer to AASHTO M 232.

- C. Caps
 - 1. Equip all pipe posts with a galvanized steel or malleable iron weather-resistant cap that fits securely over the posts, with an apron around the outside of the post.
 - a. Refer to AASHTO M 232.
 - 2. Provide cap to permit passage of top rail when top rail is used.

2.3 CHAIN LINK FABRIC

- A. Provide either Type I zinc-coated steel or Type II aluminum-coated steel fence fabric as specified in AASHTO M 181, ASTM A 392, and ASTM A 491.
- B. Provide a polyvinyl chloride (PVC) coating when shown.
 - 1. Refer to ASTM F 668
- C. Use 0.148 inch diameter wire for fence fabric 6 ft or higher and 0.120 inch diameter wire for fabric less than 6 ft high.
- D. Provide 0.177 inch diameter spiral material for tension wires.
- E. Tie fence fabric to supporting members with wire of the same diameter as the fence fabric wire.

2.4 BARBED WIRE

- A. Provide zinc-coated barbed wire when zinc-coated fence is used as specified in AASHTO M 280.
- B. Use 0.099 inch diameter barbed wire with 0.080 inch diameter 4-point barbs on 5 inch centers.
- C. Provide aluminum coated barbed wire when aluminum coated fence is used as specified in ASTM A 121.
- D. Provide a support arm for barbed wire on top of a chain link fence that supports a 200 lb vertical load at the end of the arm without causing permanent deflection.

2.5 GATES

- A. Fabricate gate posts and frames of the sizes according to FG Series Standard Drawings.
 - 1. Fasten gate frame corners together with pressed steel or malleable iron corner ells, riveted or welded as shown.

2. Galvanize welded steel gate frames after fabrication.
 - a. Refer to AASHTO M 111.
 3. Do not use closed cells that will prohibit dipping into galvanizing tanks.
- B. Follow the same standards for chain link fence fabric for covering the gate frames as for other fence fabric.
- C. Furnish each gate with the appropriate hinges, latch, and drop-bar locking device.

PART 3 EXECUTION

3.1 INSTALL POSTS

- A. Install according to FG Series Standard Drawings.
- B. Do not exceed the following spacing requirements when placing posts:

<u>Radii of Curve</u>	<u>Maximum Post Spacing</u>
Tangent or 500 ft	10 ft
200 ft to 500 ft	8 ft
100 ft to 200 ft	6 ft
0 ft to 100 ft	5 ft

- C. Install brace posts at maximum 500 ft intervals and at angle points of 30 degrees or greater.
- D. Set posts in concrete walls where required.
 1. Set posts or post sockets in concrete walls to an embedment depth of at least 18 inches.
 2. Use 0.048 inch thick galvanized metal pipe sleeve socket with an inside diameter that allows post to fit loosely.
 3. Coat the inside of the socket and the outside of the posts with bituminous paint.
 4. Use non-shrink grout to fasten the post in the socket.
- E. Set posts in concrete bases.
 1. Place concrete at least 6 inches below each post.
 2. Construct at least 12 inch diameter bases for end posts, pull posts, corner posts, gate posts, and line posts.
- F. Set posts in bridge parapets, and curbs as shown.
- G. Install chain link fence on a structure as shown.

3.2 INSTALL FENCE FABRIC

- A. Locate bottom of fence fabric on the roadway side of posts unless otherwise specified.
 - 1. Place fabric approximately 1 inch above the ground.
 - 2. Maintain a straight grade between posts by excavating high points of the ground.
 - 3. Fill depression in the natural ground to within 1 inch of the bottom of fence.
- B. Stretch the fabric taut and securely fasten to fence posts.
 - 1. Use stretch bars and metal bands to fasten fence fabric to terminal, gate, corner, and pull posts.
 - a. Space metal bands at 1 ft intervals along the post.
 - 2. Cut the fabric at corner and pull posts.
 - 3. Fasten fabric to line posts with tie wires or metal bands at 14 inch intervals.
 - 4. Attach the top edge of fabric to the top rail or tension cable with wire ties at approximately 24 inch intervals.
 - 5. Attach the bottom edge of the fabric to the bottom tension wire with wire ties spaced at 24 inch intervals.

3.3 INSTALL GATES

- A. Install single gate or double gate as shown. Install plumb, level, and secure for full opening without interference.
- B. Install ground-set items in concrete for anchorage as shown in the standard drawing or as recommended by the manufacturer. Adjust hardware for smooth operation.
- C. Set gate openings according to manufacturer's dimensions.
- D. Fabric description numbers:
 - 1. First number indicates height.
 - 2. Second number indicates width of fabric opening.

END OF SECTION

SECTION 02822

RIGHT-OF-WAY FENCE AND GATE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Right-of-way fences and gates.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 181 Chain-Link Fence
- C. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- D. AASHTO M 279: Metallic-Coated, Steel Woven Wire Fence Fabric
- E. AASHTO M 280: Metallic-Coated (Carbon) Steel Barbed Wire
- F. AASHTO M 281: Steel Fence Posts and Assemblies, Hot-Wrought
- G. ASTM A 392: Zinc-Coated Steel Chain Link Fence Fabric
- H. ASTM A 641: Zinc-Coated (Galvanized) Carbon Steel Wire
- I. ASTM F 1083: Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- J. American Wood-Preservers' Association (AWPA) Book of Standards
- K. National Electrical Code (NEC)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

Not Used

PART 2 PRODUCTS

2.1 WIRE MESH FENCE

- A. Refer to AASHTO M 279.
- B. Grade 60, nominal 0.099 inch farm grade wire mesh fencing with 6 inch vertical wire spacing.
- C. Class I zinc coating.

2.2 TYPE G WILDLIFE FENCE

- A. Galvanized, heavy duty wildlife fence fabric with fixed knots with 12 ½ gauge line and stay wires, and 6 inch vertical line spacing. Refer to AASHTO M 279.
- B. V-mesh fencing material with doubled and twisted 12½ gauge line wires with 14 gauge V-wires. Refer to AASHTO M 279.
- C. Heavy gauge chain-link, galvanized 9 gauge 2⅜ inch mesh as an alternative. Refer to ASTM A 392.
- D. Class I Zinc Coating.

2.3 BARBED WIRE

- A. Galvanized barbed wire. Refer to AASHTO M 280.
- B. Two strands of nominal 0.099 inch diameter wire twisted with a four-point nominal 0.080 inch barbs no more than 5 inches on center.

2.4 TENSION WIRE

- A. Barbless 9 gauge Class 1 Zinc Coating. Refer to AASHTO M 181.

2.5 UNTREATED WOOD POSTS FOR LINES, GATES, ENDS, AND CORNERS

- A. Native juniper.
- B. Line posts must have a minimum circumference of 10 inches.

- C. Gate, brace, and corner posts must have a minimum circumference of 12 inches.
- D. All posts must be sound, free of decay and defect, and structurally suitable.

2.6 TREATED WOOD POSTS AND WOOD BRACE RAILS

- A. Sound Douglas-fir, hemlock, or pine that is free from decay, splits, multiple cracks, any other defect, and structurally suitable.
- B. Round or sawed rectangular post and braces.
 - 1. Round posts must have a minimum diameter of 5 inches.
 - 2. Gate brace and corner posts must have a diameter of at least 5 inches.
 - 3. Rectangular posts must have a dimension of at least 4 inches x 6 inches.
 - 4. Square members, at least 4 inches x 4 inches, may be rough sawn or S4S lumber.
 - 5. No post or pole rail may deviate from a straight edge placed along its length by more than $\frac{1}{2}$ the diameter of the post or pole rail.
 - 6. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
 - 7. Fabricate posts and brace rails before pressure treating the wood members.
 - 8. Refer to Section 06055 for post and brace rail treatment.
 - 9. Apply field treatment preservatives according to AWPA Standard M4 after field drilling. Refer to AWPA Standard M4, Section 7 for accepted field treatment preservative systems.
 - 10. Keep round posts free of bark, protruding knots, and other irregularities.

2.7 METAL POSTS AND BRACES

- A. Refer to AASHTO M 281 or ASTM F 1083.
 - 1. Omit anchor plate only if the post is set in a concrete footing with a minimum cross sectional dimension of 4 inches and a depth equal to full penetration of the post.
- B. Coat fasteners with a Class 1 Coating according to ASTM A 641.
 - 1. Hot-dipped galvanized posts or painted posts may be used. Refer to AASHTO M 111.

2.8 TUBULAR-STEEL FRAME GATE WITH WIRE FABRIC

- A. Gates are not to exceed 10 feet in width.

- B. Gates greater than 7 feet require one vertical support of 1.675 inch galvanized steel tubing.
 - 1. Place pipe braces vertically in the center of each gate.
- C. Provide an adjustable truss rod of $\frac{3}{8}$ inch minimum diameter to prevent sagging on gates.
- D. Dimensions shown and specified are the minimum clear openings between gate posts. The supplier must provide a gate with fittings to fill the opening.
- E. Use wire mesh fence for gates.
- F. Supply hot-dipped galvanized steel fittings. Refer to AASHTO M 232.
- G. Frame and walk gates must be made of 1.875 inch galvanized steel tubing.
- H. Fastener for single gates must be an 18 inch length of galvanized chain secured to the gate at one end and fitted with a snap fastener on the loose end.
- I. All double drive gates must have a center latch in place of a chain fastener. A pin from the latch must fit in a socket embedded in concrete.
- J. Use 180 degree industrial hinges.
 - 1. Use hinges that will not twist, turn or allow sagging of the gate.
 - 2. Verify gates are capable of being opened and closed easily by one person.
 - 3. Pintles for gates on wood posts must be $\frac{5}{8}$ inches in diameter or larger.

2.9 FASTENERS

- A. Galvanized 9 gauge staples at least 1½ inches in length.
- B. Galvanized 9 gauge hog rings.
- C. Galvanized rail end caps and set screws.

2.10 ORNAMENTAL FENCE

- A. Galvanized fabric for a Class 1 Coating. Refer to AASHTO M 279.
- B. Galvanized posts, frames, and fittings. Refer to AASHTO M 232.

- C. Fabricate according to FG Series Standard Drawings.

2.11 CONCRETE

- A. Class B concrete. Refer to Section 03055.
- B. Contractor may substitute higher class of concrete.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clear and grade a minimum area to permit proper fence installation.

3.2 INSTALLATION

- A. Install end-braced posts in existing cross fences when intersected by the new right-of-way fence.
- B. Brace corner post in two directions.
- C. Brace end and gate posts in one direction.
- D. Compact backfill material around post to the density of the surrounding ground
- E. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.
- F. Use $\frac{3}{8}$ inch diameter x 8 inch long galvanized steel dowels to connect wood braces to the adjacent posts.
- G. Tension brace wires until installation is rigid.
- H. Rail end caps and set screw, bolt or butt weld metal braces to the metal posts.
- I. Support each timber brace with two No. 6 gauge galvanized iron wires fastened to the wood posts.
- J. Remove sags from fence fabric without causing tension crimps to fail.

- K. Install grounds according to industry standard anywhere electric transmission, distribution, or secondary lines cross a wood post fence. Refer to National Electrical Safety Code, Section 9.
- L. Install fence fabric and barbed wire on the side of the post away from the roadway.
 - 1. Attach each strand of barbed wire to the post.
- M. Install fences according to FG Series Standard Drawings.

END OF SECTION

SECTION 02823

RIGHT-OF-WAY POLE FENCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Right-of-way pole fence.

1.2 RELATED SECTIONS

- A. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

- A. American Wood-Preservers' Association (AWPA) Book of Standards

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 UNTREATED WOOD POSTS FOR LINES, GATES, ENDS, AND CORNERS

- A. Native juniper or approved equal.
- B. Line posts must have a diameter of at least 6 inches.
- C. All posts must be sound, free of decay or defects, and structurally suitable.

2.2 TREATED WOOD POSTS AND WOOD POLE RAILS

- A. Sound Douglas-fir, hemlock, or pine that is free from decay, splits, multiple cracks, any other defect, and structurally suitable.
- B. Round posts and pole rails
 - 1. Round posts must have a diameter of at least 6 inches.
 - 2. Round pole rails must have a diameter of at least 3 inches and no greater than 6 inches.
 - 3. No post or pole rail may deviate from a straight edge placed along its length by more than $\frac{1}{2}$ the diameter of the post or pole rail.

4. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
5. Fabricate posts and pole rails before pressure treatment of the wood members.
6. Treat posts and pole rails according to Section 06055.
7. Apply field treatment preservatives according to AWPAs Standard M4 after field drilling or cutting. Refer to AWPAs Standard M4, Section 7 for accepted field treatment preservative systems.
8. Keep round posts and pole rails free of bark, protruding knots, or other irregularities.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clear and grade a minimum area to permit proper fence installation.

3.2 INSTALLATION

- A. Install Right-of-Way Pole Fence according to FG Series Standard Drawings.
- B. Compact backfill material around post to the density of the surrounding ground.
- C. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.

END OF SECTION

SECTION 02825
CATTLE GUARD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cattle Guard.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 05120: Structural Steel
- E. Section 05822: Bearings

1.3 REFERENCES

- A. AASHTO M 252: Corrugated Polyethylene Drainage Pipe
- B. AASHTO/AWS D1.5: Bridge Welding Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 CATTLE GUARD

- A. Refer to SW Series Standard Drawings.

2.2 PRECAST CONCRETE CATTLE GUARD UNITS

- A. Concrete
 - 1. Class AA(AE) – Refer to Section 03055.
- B. Reinforcing Steel – Refer to Section 03211.

2.3 TRAFFIC GRILL UNITS, WELDED END GUARD UNITS, AND ATTACHMENTS

- A. Structural Steel – Refer to Section 05120.
- B. Fabrication – Refer to AASHTO/AWS D1.5.

2.4 FREE DRAINING GRANULAR BACKFILL

- A. Refer to Section 02056.

2.5 CORRUGATED POLYETHYLENE PIPE

- A. Refer to AASHTO M 252.

2.6 BEARING PAD STRIPS

- A. Elastomeric Bearing Pads – Refer to Section 05822.

PART 3 EXECUTION

3.1 GENERAL

- A. Construct cattle guard according to SW Series Standard Drawings.

END OF SECTION

SECTION 02827

WILDLIFE ESCAPE RAMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Standard, Combination, and Corner Wildlife Escape Ramps.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02822: Right-of-Way Fence and Gate
- C. Section 02911: Hydraulic Erosion Control Products
- D. Section 02912: Topsoil
- E. Section 02922: Seed, Turf Seed, and Turf Sod Section
- F. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

- A. American Wood-Preservers' Association (AWPA) Book of Standards

1.4 DEFINITIONS

- A. Combination Wildlife Escape Ramp – Three earthen ramps, two opposite each other and perpendicular to the right-of-way fence plus one between them parallel perpendicular to the right-of-way fence creating a three-sided corral for animals to jump into to escape from the right-of-way. Refer to FG Series Standard Drawings.
- B. Corner Wildlife Escape Ramp – An earthen ramp placed in the corner of the right-of-way fence to allow wild animals to escape from the right-of-way. Refer to FG Series Standard Drawings.
- C. Standard Wildlife Escape Ramp – An earthen ramp perpendicular to the right-of-way fence to allow wild animals to escape from the right-of-way. Refer to FG Series Standard Drawings.

1.5 SUBMITTALS

Not Used

PART 2 PRODUCTS

2.1 TIMBER PLANKS

- A. Sound lodgepole pine, ponderosa pine, Engelmann spruce, Douglas-fir, hem-fir, or western larch of grading WWPA No. 2 treated and free from decay, splits, multiple cracks, any other defect, and structurally suitable. Refer to Section 06055.

2.2 TREATED WOOD POSTS AND WOOD BRACE RAILS

- A. Sound Douglas-fir, hemlock, or pine that is free from decay, splits, multiple cracks, or any other defect, and structurally suitable.
- B. Round posts and braces
 1. Round posts must have a diameter of at least 7 inches.
 2. Round wood brace rails must have diameter of at least 5 inches.
 3. No post or pole rail may deviate from a straight edge placed along its length by more than $\frac{1}{2}$ the diameter of the post or pole rail.
 4. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
 5. Fabricate posts and brace rails before pressure treating the wood members.
 6. Apply field treatment preservatives according to AWPA Standard M4 after field drilling.
 - a. Refer to AWPA Standard M4, Section 7 for accepted field treatment preservative systems.
 7. Refer to Section 06055 for post and brace rail treatment.
 8. Keep round posts free of bark, protruding knots, or other irregularities.

2.3 TYPE G WILDLIFE FENCE FABRIC

- A. Refer to Section 02822.

2.4 NAILS OR SCREWS

- A. Use 20d galvanized nails or zinc plated steel lag screws $\frac{5}{16}$ x 4 inch.

2.5 EMBANKMENT MATERIAL

- A. Refer to Section 02056.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate Wildlife Escape Ramps by type as shown.
- B. Clear and grade within the footprint of the Wildlife Escape Ramp to permit proper installation.
- C. Install Wildlife Escape Ramp according to FG Series Standard Drawings.
- D. Place embankment material for ramp as shown on the isometric view. Refer to FG Series Standard Drawings.
- E. Cover the Wildlife Escape Ramp with topsoil, broadcast seed, and HECP Type 1 mulch after placing embankment. Refer to Sections 02912, 02922, and 02911.

END OF SECTION

SECTION 02841

W-BEAM GUARDRAIL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. W-Beam guardrail, post and blocks, W-Beam guardrail transition element, W-Beam guardrail anchors, W-beam buried in back slope terminals, W-Beam curved guardrail elements, W-Beam nested guardrail, W-Beam guardrail delineation and certification requirements for installation of W-Beam guardrail systems.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02842: Delineators
- C. Section 02890: Retroreflective Sheeting
- D. Section 03055: Portland Cement Concrete
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. AASHTO M 160: General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling
- C. AASHTO M 180: Corrugated Sheet Steel Beams for Highway Guardrail
- D. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. AASHTO M 270: Carbon and High Strength Low Alloy Structural Steel, Shapes, Plates and Bars and Quenched-and Tempered Alloy Structural Steel Plates for Bridges

- F. AASHTO M 298: Coatings of Zinc Mechanically Deposited on Iron and Steel
- G. ASTM A 500: Cold Formed Welded and Seamless Carbon Steel Structure tubing in Rounds and Shapes

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Certificate of compliance for all products.
- B. Guardrail Training Certificate – Refer to this Section, Article 1.6.

1.6 TRAINING REQUIREMENT

- A. Attend the Department's Guardrail Installation Training Course (GRIT) and pass the UDOT Guardrail Training Final Examination.
 - 1. Alternative to UDOT Grit Course is the American Traffic Safety Services Association (ATSSA) Guardrail Installation Training.
- B. Submit Guardrail Training Certificate before beginning installation.
- C. Have a certified guardrail installer present at each location within the project and be an active participant during the installation and maintenance repair of guardrail or elements of a W-Beam guardrail system.

PART 2 PRODUCTS

2.1 W-BEAM GUARDRAIL AND HARDWARE

- A. W-Beam Rail – Refer to BA Series Standard Drawings.
 - 1. Minimum galvanizing requirement: Refer to AASHTO M 180, Type 1. Class A.
- B. Bottom W-Beam rail or steel rub rail – Refer to BA Series Standard Drawings.
 - 1. W-Beam – Refer to requirements of this Section.
 - 2. Channel rub rail – Refer to AASHTO M 160 and AASHTO M 270.
 - a. Galvanize according to AASHTO M 111 after punching and cutting is complete.
- C. Hardware – Refer to BA Series Standard Drawings.
 - 1. Manufacturer – Refer to AASHTO M 180.

2. Coatings – Refer to AASHTO M 232 or M 298.

2.2 W-BEAM GUARDRAIL POSTS AND OFFSET BLOCKS

- A. All elements according to BA Series Standard Drawings.
 1. Steel post – Refer to AASHTO M 270 and AASHTO M 160.
 - a. Galvanize according to AASHTO M 111 after punching and cutting is complete.
 2. Wood Post and wood blocks – Refer to Section 06055.
 3. Composite or plastic offset blocks for steel post installations.
 - a. Certify according to MASH test requirements.

2.3 TRANSITION ELEMENTS

- A. All elements according to BA Series Standard Drawings.

2.4 ANCHOR ELEMENTS

- A. All elements according to BA Series Standard Drawings.
 1. Refer to the requirements of this Section for W-Beam guardrail, posts, blocks, and hardware.
 2. Anchor Plate – Refer to AASHTO M 270.
 - a. Galvanize according to AASHTO M 111 after punching, drilling, and cutting is complete.
 3. Bearing Plate – Refer to AASHTO M 270.
 - a. Galvanize according to AASHTO M 111 after punching, drilling, and cutting is complete.
 4. Anchor Post Foundation Tube and Plate.
 - a. Tube – Refer to ASTM A 500.
 - b. Plate – Refer to AASHTO M 270.
 - c. Galvanize according to AASHTO M 111 after punching, drilling, cutting, and welding is complete.

2.5 W-BEAM BURIED-IN-BACKSLOPE TERMINALS

- A. All elements according to BA Series Standard Drawings.
 1. Refer to plan set for terminal requirement.
 2. Refer to BA Series Standard Drawings for Buried-In-Backslope Terminal Anchor options.
 - a. Steel Post with plate – Refer to AASHTO M 270 and AASHTO M 160. Galvanize according to AASHTO M 111 after punching, drilling, cutting, and welding is complete.
 - b. Concrete Block – Use Class A(AE) concrete. Refer to Section 03055. Refer to Section 03211 for reinforcing steel requirement.

2.6 W-BEAM CURVED GUARDRAIL

- A. All elements according to BA Series Standard Drawings.
 - 1. Refer to plan set for radius requirements.
 - 2. Shop bend curves.
 - 3. Refer to this Section for W-Beam guardrail and anchor system.
 - 4. Controlled Release Terminal Post (CRT) breakaway post according to wood post and block requirements of this Section.
 - a. Drill two 3½ inch holes center of post, 29 and 45 inches from top of post.

2.7 W-BEAM NESTED GUARDRAIL

- A. All elements according to BA Series Standard Drawings.
 - 1. W-Beam – Refer to requirements of this Section.
 - 2. CRT breakaway post – Refer to wood post and block requirements of this section.
 - a. Drill two 3½ inch holes center of post, 29 and 45 inches from top of post.

2.8 W-BEAM MEDIAN BARRIER

- A. All elements according to BA Series Standard Drawings.
 - 1. Refer to requirements of this section for W-Beam guardrail, posts, blocks, rub rail channel, and hardware.

2.9 BARRIER DELINEATION

- A. Sheeting – Refer to Section 02890.
- B. Hardware – Refer to GW Series Standard Drawings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Site
 - 1. Complete grading requirements before installation of guardrail, guardrail end treatment, and crash cushions.
 - a. Obtain approval of site grading, approach and recovery areas, and layout before system installation.

2. Protect work area when removing guardrail barriers, guardrail end treatment, or crash cushions until the barriers, guardrail end treatment, or crash cushion are reconstructed or the hazard is mitigated.

3.2 POSTS AND BLOCKS

- A. Drill required holes in posts and blocks according to BA Series Standard Drawings before installation.
 1. Field drilling post is acceptable when installing the bottom rail.
 - a. Coat field drilled steel post with a field-applied cold zinc material.
- B. Drive post if satisfactory results are obtained without damaging the post.
 1. Do not drive posts through asphalt.
 2. Refer to BA 4D Series Standard Drawings.
- C. Excavate postholes when not driven.
 1. Compact approved backfill material into bottom of hole if hole is over excavated.
 2. Compact backfill material around post to the satisfaction of the engineer.
 - a. Refer to Section 02056.

3.3 RAIL ELEMENTS

- A. Drill or punch required holes according to BA Series Standard Drawings before installation.
 1. Field drilled holes in rail element are permitted on a limited basis, when required.
 - a. Drill no more than three holes on three consecutive posts.
 - b. Coat all field drilled rail elements with a field-applied cold zinc material.
- B. Shop bend curved sections as required in BA Series Standard Drawings.

3.4 DELINEATION

- A. Install delineation according to BA and GW Standard Drawings.

3.5 RAISING EXISTING W-BEAM GUARDRAIL

- A. Raise W-beam guardrail to maintain the minimum rail height according to BA Series Standard Drawings.
 - 1. Only W-beam guardrail with two or three-hole post system is eligible to be raised.
 - a. Raise the two or three-hole post systems rail element only if the rail element is not currently set in the highest hole.
 - 2. W-beam guardrail with single-hole post system cannot be raised. Do not lift posts in order to raise rail.
- B. Remove existing rail element and blocks.
- C. Complete shoulder grading as required by BA Series Standard Drawings.
- D. Reinstall rail elements and blocks on existing two or three-hole post system using the next hole up on the two or three-hole system to meet the height requirements according to BA Series Standard Drawings.
 - 1. Do not drill new holes in posts.

END OF SECTION

SECTION 02842

DELINEATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Delineators, Type I and Type II.
- B. Culvert and maintenance markers.
- C. Freeway turnaround markers.

1.2 RELATED SECTIONS

- A. Section 02765: Pavement Marking Paint
- B. Section 02890: Retroreflective Sheeting

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- C. ASTM D 638: Tensile Properties of Plastics
- D. ASTM D 4956: Standard Specification for Retroreflective Sheeting for Traffic Control
- E. ASTM G 23: Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 STEEL POSTS

- A. Supply and galvanize posts as specified. Refer to ASTM A 1011 and AASHTO M 111.
- B. Use flanged, channel-shaped steel posts that weight 2 lb/ft.
- C. Make all cuts before galvanizing posts. Refer to GW Series Standard Drawings.

2.2 FLEXIBLE POSTS

- A. Free of burns, discoloration, contamination, and other defects.
- B. Remains flexible at temperatures from -5 degrees F to +140 degrees F.
- C. Capable of being driven into an earth shoulder with or without a pilot hole.
- D. Tensile strength of 1,100 psi. Refer to ASTM D 638.

2.3 QUALITY CONTROL – FLEXIBLE POST TESTING

- A. Meet Cold Bend Test
 - 1. Subject two posts to a temperature of -10 degrees F, $\pm$ 5 degrees F for at least four hours.
 - 2. Immediately bend each post four times through a 90 degree angle around a 2 inch mandrel.
 - 3. Each post must return to its original straight configuration within a $\pm$ 10 degree angle within five minutes at the end of the four bends.
 - 4. Any cracking or significant loss of rigidity are grounds for failure.
- B. Meet Hot Bend Test
 - 1. Subject two posts to a temperature of 100 degrees F $\pm$ 5 degrees F for at least four hours.
 - 2. Satisfy all bending and physical requirements specified in the Cold Bend Test.
- C. Meet Impact Resistance Test
 - 1. Subject post to impacts by a typical sedan as follows:
 - a. Three hits - 0 degree angle at 0 degrees F.
 - b. Three hits - 0 degree angle at 100 degrees F.
 - c. Ten hits - 0 degree angle at 35 mph.
 - d. Five hits - 15 degree angle at 55 mph.

2. Acceptable Results
 - a. Installed post remain intact, securely anchored, and within ± 10 degrees of vertical orientation.
 - b. Installed post shows minimal signs of cracking or loss of rigidity.
 - c. Installed post retains at least 50 percent of its reflective sheeting.
 - d. Impact vehicle suffers little or no damage during the impact test.
- D. Exposure
 1. Expose the specimens for 500 hours in a carbon arc-type apparatus according to ASTM G 23, Method 1.
 2. Acceptable results:
 - a. Exposure does not result in delamination, distress, or discoloration.
 - b. Sheeting is not removable from the specimens without damage.
 - c. Post is resistant to ultraviolet light, ozone, hydrocarbons, and other weathering.

2.4 SHEETING

- A. Refer to Section 02890.

2.5 PAINT

- A. Refer to Section 02765.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Posts – Visibly free of bends or twists both before and after installation.

END OF SECTION

SECTION 02843

CRASH CUSHIONS AND BARRIER END TREATMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Crash cushions and barrier end treatments.
- B. Crash cushion and barrier end treatment markers.

1.2 RELATED SECTION

- A. Section 02890: Retroreflective Sheeting

1.3 REFERENCES

- A. Energite® III Module Systems Design Manual
- B. Manual for Assessing Safety Hardware (MASH)
- C. NCHRP Report 350 – Recommended Procedures for the Safety Performance Evaluation of Highway Features
- D. UDOT Guidelines for Crash Cushions and Barrier End Treatments.

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Installer Certification
 - 1. Manufacturer certified installer.
 - 2. Provide proof of certification before installation.
- B. Letter of certification for each system location affirming it is installed according to Department's and the manufacturer's specifications before substantial completion.
 - 1. Use Form C-112 available on the Department's Web site. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 - 2. Reference project number and describe station/location indicating median, left or right shoulder, or gore area application.
- C. Shop and installation drawings for each system type supplied – For information.

PART 2 PRODUCTS

2.1 CRASH CUSHION AND BARRIER END TREATMENTS

- A. Select from the approved products list within the UDOT Guidelines for Crash Cushions and Barrier End Treatments.
 - 1. Refer to the UDOT Guidelines for Crash Cushions and Barrier End Treatments, for specific uses and requirements for each approved system type. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
 - 2. Refer to CC Series Standard Drawings for crash cushion or end treatment grading and marker requirements.
- B. Crash Cushion Types
 - 1. Type A.
 - a. Supply system with an adequate width as shown.
 - b. Include additional fender panels, posts and hardware to gain the required width for hazard protection greater than the manufactured width of a system.
 - c. Supply system for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments,.
 - d. Galvanize steel parts according to manufacturer's requirements.
 - e. Supply transition element for the approach of opposing traffic when system is installed with bi-directional traffic and the back of system is within the maximum required clear zone.
 - 1) Two transition elements required when system is installed with W-beam median barrier.
 - f. Supply crash cushion markers. Refer to CC Series Standard Drawings.
 - 2. Type B – Protects fixed hazards up to 3 ft wide and within 15 ft of traveled way, with less than 100 ft of longitudinal space in front of the hazard.
 - a. Supply system with an adequate width as shown.
 - b. Supply systems for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments,.
 - c. Galvanize steel parts according to manufacturer's requirements.
 - d. Supply transition element for the approach of opposing traffic when system is installed with bi-directional traffic and the system is within the maximum required clear zone.
 - 1) Two transition elements required when system is installed with W-beam median barrier.
 - e. Supply crash cushion markers. Refer to CC Series Standard Drawings.

3. Type C – Protects the approach ends of median W-beam guardrail when the longitudinal space in front of the hazard is greater than 100 ft.
 - a. Galvanize steel parts according to manufacturer's requirements.
 - b. Supply double-sided W-beam transition element when system is installed in conjunction with concrete barrier or bridge parapet. Refer to BA 4 Series Standard Drawings.
 - c. Supply crash cushion markers. Refer to CC Series Standard Drawings.
4. Type D.
 - a. Supply system with an adequate width as shown.
 - b. Supply system for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments, edition.
 - c. Galvanize steel parts according to manufacturer's requirements.
 - d. Supply transition element for the approach of opposing traffic when system is installed with bi-directional traffic and the back of system is within the maximum required clear zone.
 - 1) Two transition elements required when system is installed with W-beam median barrier.
 - e. Include fender panels, posts and hardware to gain the required width for hazard protection greater than the manufactured width of a system.
 - f. Supply crash cushion markers. Refer to CC Series Standard Drawings.
5. Type E – Sand Barrel Arrays
 - a. Design sand barrel array using Energite® III Module Systems design manual.
 - 1) Design sand barrel array to meet roadway design speed.
 - b. Certify sand barrels and components meet NCHRP-350 for non-re-directive gating crash cushions.
 - c. Construct sand barrels using a frangible polyethylene material that will shatter upon impact.
 - 1) Use yellow sand barrels.
 - 2) Permanently apply manufactured date, month, and year to each piece of the barrel system.
 - 3) Use one or two piece barrel construction.
 - 4) Interface cones with the barrel to prevent sand leakage but allow for drainage of excess water for sand barrel systems that use barrel and cone configuration.
 - 5) Provide lids for each sand barrel. Fasten lid securely to barrel.

- d. Provide sand barrels that hold the required amounts of sand according to requirements of the typical sand barrel array.
 - 1) 200 lb, 400 lb, 700 lb, 1,400 lb, and 2,100 lb.
 - 2) Mark each barrel in a manner that the amount of sand required for the nominal weight is visible for systems that are designed using barrels for multiple sand weight requirements.
 - e. Fill modules with dry sand containing no more than 2 percent moisture.
 - f. Supply crash cushion markers and construct pad. Refer to CC Series Standard Drawings.
- C. End Treatment Types
 - 1. Type F
 - a. Galvanize steel parts according to manufacturer's requirements.
 - b. Supply crash cushion markers. Refer to CC Series Standard Drawings.
 - 2. Type G
 - a. Supply post option as described in UDOT Guidelines for Crash Cushion and Barrier End Treatments, edition.
 - b. Supply system with 12½ ft galvanized W-beam rail elements according to manufacturer's requirements.
 - c. Supply manufacturer approved impact head and hardware.
 - d. Galvanize steel parts according to manufacturer's requirements.
 - e. Supply crash cushion markers. Refer to CC Series Standard Drawings.
 - 3. Type H
 - a. Supply post option as described in UDOT Guidelines for Crash Cushion and Barrier End Treatments, edition.
 - b. Supply system with 12½ ft galvanized W-beam rail elements according to manufacturer's requirements.
 - c. Supply manufacturer approved impact head or end section and hardware.
 - d. Galvanize steel parts according to manufacturer's requirements.
 - e. Supply crash cushion markers. Refer to CC Series Standard Drawings.

2.2 CRASH CUSHION MARKERS

- A. Marker plate and self-adhesive sheeting requirements:
 - 1. Refer to CC Series Standard Drawings.

2. Construct marker plate 18 x 18 inches using 0.032 gauge aluminum with appropriate object marker sheeting.
 - a. Drill a $\frac{7}{16}$ inch hole in each corner of plate.
 - b. Sheeting – Refer to Section 02890.
 - 1) Date placement specified in Section 02890 is not required.
 3. Use of self-adhesive sheeting without marker plate. Sheeting – Refer to Section 02890.
 - a. Date placement specified in Section 02890 is not required.
 - b. Use appropriate sheeting type for the substrate that sheeting is placed on.
 - c. Place a minimum of 324 in², typically 18 x 18 inch, on the approach end of crash cushion or barrier end treatment.
 - d. Use of manufacturer's supplied object marker sheeting is acceptable when sheet type and amount meet or exceed requirements
- B. Construct marker post 60 inches long and 2 inches OD using black polyethylene material
1. Marker Post – Refer to CC Series Standard Drawings.
 - a. Close top of marker post.
 - b. Drill three $\frac{7}{16}$ inch mounting holes.
 - c. Apply three 4 inch bands of yellow sheeting. Refer to Section 02890.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prepare site to finished grade before installing crash cushion or barrier end treatment.
1. Construct approach areas and recovery areas to meet CC Series Standard Drawings and system requirements before system installation.
 2. Construct concrete pad according to system requirements when applicable.
 - a. Crash Cushion Types A, B, and D require concrete pad constructed to manufacturer's requirements when installed in a permanent application.
 - b. End Treatment Type F QuadTrend 350 requires a concrete pad and concrete anchor system in all applications. Refer to manufacturer's requirements.
 - c. End Treatment Type F BEAT-SSCC can be mounted on a concrete pad with surface mounted posts. Refer to manufacturer's concrete pad and mounting requirements.

- d. Crash Cushion Type C and End Treatment Types F, G, and H.
 - 1) Create block out hole by forming, saw cutting, or other similar method required when installing ground mounted system into asphalt or concrete.
 - 2) Refer to BA 4D Series Standard Drawings.
 - e. Use manufacturer's specification for concrete pad construction.
 - f. Refer to CC Series Standard Drawings for Type E sand barrel detail, for pad requirements.
 - 3. Obtain approval of site grading, approach and recovery areas, and layout before system installation.
 - 4. Compact backfill material around posts and foundation tubes with mechanical effort to match the density of the surrounding soil.
- B. Install crash cushion and barrier end treatments according to:
- 1. CC Series Standard Drawings and UDOT Guidelines for Crash Cushion and Barrier End Treatments.
 - 2. Manufacturer's specifications and recommendations.
 - 3. Use manufacturer certified installer to perform the installation.
- C. Repair or replace permanent systems damaged before final acceptance within 24 hours of notification of damage.
- 1. Exceptions include.
 - a) Damage is caused by an errant vehicle other than a vehicle operated by the Contractor or a subcontractor.
 - b) Damage occurs after traffic has been established in the final lane configuration with shoulders as established in the project plans.
 - 2. Payment will be made using a force account basis for the cost of repair or replacement of the damaged system when the Engineer determines the conditions described under the exception in this Section, Article 3.1, paragraph C1a apply.

END OF SECTION

SECTION 02844

CONCRETE BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricating and placing precast concrete barriers including New Jersey and constant slope shapes.
- B. Placing cast-in-place constant slope barriers.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02075: Geotextiles
- C. Section 02842: Delineators
- D. Section 03055: Portland Cement Concrete
- E. Section 03056: Self-Consolidating Concrete (SCC)
- F. Section 03152: Concrete Joint Control
- G. Section 03211: Reinforcing Steel and Welded Wire
- H. Section 03310: Structural Concrete
- I. Section 03390: Concrete Curing
- J. Section 03392: Penetrating Concrete Sealer
- K. Section 09981: Concrete Coating
- L. Section 13553: ATMS Conduit

1.3 REFERENCES

- A. ASTM A 36: Carbon Structural Steel
- B. ASTM C 1315: Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

- C. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
- D. ASTM D 1777: Thickness of Textile Materials
- E. ASTM D 6364: Determining Short-Term Compression Behavior of Geosynthetics
- F. AWS D1.5: Bridge Welding Code
- G. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(AE) – Refer to Section 03055.
- B. SCC – Refer to Section 03056.

2.2 STRUCTURAL STEEL

- A. Connection pins, connection loops, and stabilization pins. Refer to ASTM A 36.
- B. Welding – Refer to AWS D1.5.

2.3 REINFORCING STEEL

- A. Refer to Section 03211.

2.4 BARRIER SEAL

- A. Polyester polyurethane open-cell foam 100 percent impregnated with asphalt.
- B. Foam Unit Weight Requirements
 - 1. Before impregnation 68 lbs/yd³ to 85 lbs/yd³
 - 2. After impregnation 252 lbs/yd³ to 270 lbs/yd³
- C. Impregnated asphalt foam returns to 95 percent of its original volume when compressed to 25 percent of its volume and released.

- D. Impregnated asphalt foam remains stable at temperatures ranging from -40 degrees F to +150 degrees F.

2.5 CONCRETE BARRIER

- A. Refer to BA Series Standard Drawings for reinforcing steel.

2.6 PRECAST NEW JERSEY SHAPE AND CONSTANT SLOPE CONCRETE BARRIER

- A. Pre-qualify the fabricator as a supplier of precast concrete products according to the UDOT Quality Management Plan: Precast-Prestressed Concrete Structures.
- B. Mark each barrier with 1½ inch numbers indicating the date of casting and identification number supplied by the inspector.
 - 1. Mark "WORK ZONE ONLY" if barrier uses uncoated reinforcement.
 - 2. Impress ¼ inch deep into the top center of the barrier.
- C. Prevent cracking or damage during handling and storage of precast units. Replace units with cracks greater than .007 inch or damaged precast units.
- D. Do not ship until:
 - 1. 28 day compressive strength acquired.
 - 2. Cured and sealed according to Section 03390.
 - 3. Inspected and authorized.

2.7 BARRIER DELINEATION

- A. Sheeting – Refer to Section 02842.
- B. Hardware – Refer to GW Series Standard Drawings.

2.8 SURFACE SEALING MATERIAL

- A. Penetrating concrete sealer – Refer to Section 03392.
- B. Concrete coating – Refer to Section 09981.
 - 1. Use only when colored concrete coating is specified.
 - 2. Coating system includes water repellent and two coats of tinted concrete sealer.

2.9 EXTRUSION AND SLIP FORM MACHINES FOR CAST-IN-PLACE CONSTANT SLOPE BARRIER

- A. Use equipment capable of vertical adjustment to the grade line while in forward motion.
- B. Use equipment with an attached grade line gauge or pointer to make a continual comparison with the barrier being placed and the offset guideline.
- C. Use equipment capable of accommodating pavement to barrier reinforcing bars.

2.10 CAST-IN-PLACE CONSTANT SLOPE CONCRETE BARRIER

- A. Electrical/ATMS Conduits, Junction Boxes, and Pull Boxes
 - 1. Size and quantity according to contract drawings.
 - 2. Refer to Section 13553.
- B. Expansion Joints – Refer to Section 03152.

2.11 COMPOSITE DRAINAGE MATERIAL

- A. Use a two-layer geocomposite sheet drain consisting of drainage geotextile bonded to one side of a three-dimensional drainage core.
 - 1. Drainage geotextile – Refer to Section 02075.
 - 2. Drainage core:
 - a. High strength polystyrene or polypropylene.
 - b. Minimum compressive strength – 15,000 lbs/ft². Refer to ASTM D 1621 or ASTM D 6364.
 - c. Minimum thickness – 0.40 inches. Refer to ASTM D 1777.
 - d. Capable of multidirectional flow.

2.12 RIGID PLASTIC FOAM

- A. Refer to Section 03310.

PART 3 EXECUTION

3.1 PREPARATION

- A. Site Considerations
 - 1. Protect work area when removing traffic barriers and crash cushions until the barriers and crash cushion are reconstructed or the hazard is mitigated. Refer to Section 01554.
 - 2. Precast Concrete Barrier:
 - a. Complete grading requirements and place any required paved surfaces before installing barrier.
 - 1. Refer to BA Series Standard Drawings.
 - b. Complete grading requirements before barrier or crash cushion installation.
 - 1. Refer to CC Series Standard Drawings.
- B. Cast-In-Place Constant Slope Barrier
 - 1. Give the surface a final soft brush finish with strokes parallel to the line of barriers before applying curing compound.
 - 2. Do not finish with a brush application of grout.
 - 3. Refer to Section 03392.
 - 4. Complete grading requirements before crash cushion installation.
 - a. Refer to CC Series Standard Drawings.

3.2 PRECAST CONCRETE BARRIER – 32 INCH NEW JERSEY SHAPE AND CONSTANT SLOPE CONCRETE BARRIER – 42 INCH

- A. Installation includes moving, stockpiling, and placing all barriers.
- B. Place seal between each barrier unit so that enough pressure is exerted on the sealing material to form and maintain a permanent bond.
- C. Refer to BA Series Standard Drawings.
- D. Curing – Refer to Section 03390.

3.3 CAST-IN-PLACE CONSTANT SLOPE CONCRETE BARRIER – 42 INCH AND 54 INCH

- A. Obtain Engineer approval before placing the barrier.
- B. Refer to BA Series Standard Drawings.
- C. Fixed forms – Do not use precast mortar blocks to support the reinforcing steel.

- D. Constant Slope Barrier Placed by Extrusion or Slip Form
 - 1. Provide an offset guideline for the extrusion or slip form machine to maintain the predetermined grade.
 - 2. Feed concrete to the extrusion or slip form machine at a uniform rate.
 - 3. Operate machine uniformly restraining forward motion.
 - a. Produce well-compacted, dense concrete with consistency that maintains the shape of the barrier without support.
 - b. Produce a well-compacted mass of concrete free from surface pits larger than 1 inch in diameter and requiring no further finishing.
 - 4. Saw or cut joints before applying curing compound.
- E. Mark barrier at beginning, end, and 1,000 ft intervals with 1½ inch numbers indicating the date of casting.
 - 1. Impress ¼ inch deep into the front face of barrier, 6 inches below the top.
- F. Curing – Refer to Section 03390.
- G. Seal concrete surfaces with a penetrating concrete sealer or a concrete coating.
 - 1. Penetrating concrete sealer
 - a. Use when a colored concrete coating is not specified.
 - b. Not required when curing compound meets ASTM C 1315. Refer to Section 03390.
 - c. Refer to Section 03392.
 - 2. Concrete Coating
 - a. Use when a colored concrete coating is specified.
 - b. Refer to Section 09981.

3.4 DELINEATION HARDWARE

- A. Concrete Barrier – Attach L Barrier Reflector. Refer to GW Series Standard Drawings.
- B. Attachment Location – Refer to BA Series Standard Drawings.
- C. Application – Refer to GW Series Standard Drawings.

END OF SECTION

SECTION 02845

HIGH TENSION CABLE BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cable barrier materials and cable barrier/W-beam guardrail anchor systems.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02056: Embankment, Borrow, and Backfill
- C. Section 02841: W-beam Guardrail
- D. Section 02843: Crash Cushions
- E. Section 02890: Retroreflective Sheeting
- F. Section 03055: Portland Cement Concrete
- G. Section 03211: Reinforcing Steel and Welded Wire
- H. Section 05120: Structural Steel

1.3 REFERENCES

- A. AASHTO M 30: Zinc coated Steel Wire Rope and Fittings for Highway Guardrail
- B. AASHTO M 268: Retroreflective Sheeting for Traffic Control
- C. AASHTO AWS D1.1: Structural Welding Code – Steel
- D. ASTM A 36: Carbon Structural Steel
- E. ASTM A 123: Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- F. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

- G. ASTM A 709: Carbon Structural Steel
- H. ASTM A 741: Zinc-Coated Wire Rope and Fittings for Highway Guardrail
- I. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- J. International Organization for Standardization (ISO) Standards
- K. NCHRP 350: Recommended Procedures for the Evaluation of Highway Features
- L. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Training materials, manuals, and shop drawings for information – Refer to this Section, Article 1.6.
- B. Letters of Acceptance – Refer to this Section, Article 2.1, paragraph C.
- C. Certification – Refer to this Section, Article 2.2, paragraph A1a.
- D. Tension log for information. Refer to this Section, Article 3.6, paragraph C.
- E. Installation details, parts list, and contacts
 - A. Furnish the following before physical completion:
 - 1. Four sets of system installation details and parts list.
 - 2. Supply parts to the location determined by the Engineer 48 hours of notification.
 - 3. List and contact information for repair part suppliers.
 - 4. List of Utah-based, manufacturer-trained installers.

1.6 TRAINING AND LITERATURE

- A. Provide all training materials in both hard copy and electronic PDF format.

- B. Notify and provide installation and maintenance training and certification.
 - 1. Training conducted by the supplying manufacturer.
 - a. Provide one training session a minimum of 14 days before installing the system to the following:
 - 1) Contractor (Prime)
 - 2) Installation Contractor (Sub)
 - 3) Resident Engineer and designee
 - b. Provide one training session before the physical completion and invite one or both of each of the following:
 - 1) Region Maintenance Engineer and designee
 - 2) Region Operations Engineer and designee
 - 3) District Engineer and designee
 - 4) Area Supervisor and designee
 - 5) Local Maintenance Station personnel
 - 6) Engineer for Maintenance (Complex) and designee
 - 7) Representative from the Division of Traffic and Safety
 - 8) FHWA-Utah Division representative
 - 2. Provide 4 sets of shop drawings and manuals.
 - a. Training Materials
 - 1) Installation manuals.
 - 2) Maintenance manuals.
 - 3) Materials deemed necessary to conduct training for proper installation and maintenance of cable barrier system.
 - b. Shop drawings for the installation of the following:
 - 1) Cable Barrier Terminal (NCHRP 350 approved)
 - 2) Cable Barrier Approach Transition
 - 3) Typical installation of line posts and cable
 - c. Distribution
 - 1) Resident Engineer
 - 2) Prime Contractor
 - 3) Installation Contractor (Sub)
 - 4) Local Maintenance Station
 - 3. Install W-beam components using an installer who meets the requirements for training established in Section 02841.
 - 4. Install Crash Cushion and End Treatment components using an installer who meets the requirements for training established in Section 02843.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide cable barrier system with the following requirements:
 - 1. Capable of roadside or median installation.

2. System meeting NCHRP 350 Test Level 3 on a 6H:1V or flatter slope.
 3. Maximum deflection of 8 ft under NCHRP 350 TL-3 conditions with 10 ft post spacing.
 4. Capable of post and cable separation during impact.
 5. Produce no flying debris capable of vehicle windshield intrusion.
 6. Non-NCHRP 350 anchor.
 7. Cable Barrier Concrete Bridge Departure Parapet Bracket.
 8. Cable Barrier/W-beam Guardrail Attachment Assembly.
 9. Cable Barrier/W-beam Guardrail Anchor Assembly.
 10. Cable Barrier/W-beam Guardrail Attachment Rail.
 11. Provide socketed cast-in-place concrete foundations for line post
- B. Provide hardware and miscellaneous items associated with cable barrier system, cable barrier/W-beam attachment assembly, and cable barrier/W-beam guardrail anchor assembly.
- C. Receive pre-qualification of system before bidding.
1. Provide Department's Letter of Acceptance.
 2. Provide manufacturer's FHWA Letters of Acceptance
- D. Supply system parts within 48 hours of request.
- E. Conduct manufacturer-supplied training a minimum of 14 days before installing the system.

2.2 MATERIALS

- A. Wire Rope – Galvanized wire rope $\frac{3}{4}$ inch 3 x 7, construct according to AASHTO M 30/ASTM A 741 Type I, Class A coating, with a Modified Breaking Strength Minimum equal to 39,000 lb.
1. Wire rope meets manufacturer's specifications. Pre-stretch wire rope during manufacturing to exhibit a minimum wire rope modulus of elasticity of 19,000,000 psi according to ISO 12076-202, Wire Rope Modulus of Elasticity with no bedding or pre-stretching of the rope permitted in testing.
 - a. Furnish a separate certification from the wire rope manufacturer stating it meets the cable barrier manufacturer's requirements if the wire rope is an out-sourced product of the cable barrier system manufacturer.
 - b. Factory swaged ends on each end of typical cable length.
 - 1) Each cable must have a left hand thread on one end and a right hand thread on the other end, 1 inch in diameter. Ends able to accept a closed body style turnbuckle.
 - 2) Provide galvanized hardware.

- B. Hardware and Miscellaneous Items
1. Meet manufacturer's requirements for hardware and miscellaneous items as outlined in the manufacturer's specifications for the installation of the cable barrier system. Furnish galvanized hardware when applicable. Items to include but not limited to the following:
 - a. Anchor and terminal fittings
 - 1) 1 inch diameter fittings required
 - b. Turnbuckles, rigging screws, field splice connections
 - 1) 1 inch diameter fittings required
 - c. Parts used to separate and hold cable barrier at designed height.
 - d. Use post cap when required under this Section, Article 3.7, paragraph B2 for the purpose of attaching delineation directly facing traffic.
- C. Line post, sleeve sockets – 3 ft, 5 ft, and 10 ft post spacings.
1. Size as shown in manufacturer's specifications.
 - a. Line posts
 - 1) Meet all manufacturers' specifications.
 - 2) Posts specified in ASTM A 1011 or ASTM A 36.
 - 3) Galvanize according to ASTM A 123, after fabrication.
 - 4) Post is able to hold the wire ropes at the design height.
 - b. Line post sleeve
 - 1) Steel sleeves to manufacturers' specifications for cast-in-place post foundation option.
 - 2) Steel sleeves constructed using material according to ASTM A 500.
 - 3) Weld according to AASHTO/AWS D1.1.
 - 4) Galvanize according to ASTM A 123, after fabrication.
 2. Line post foundations, cast-in-place with sleeve.
 - a. Cast-in-place post foundation requires completely filling each excavated hole with concrete.
 - 1) Concrete class AA(AE) – Refer to Section 03055.
 - a) Foundation, 12 inch diameter, 42 inch depth.
 - 2) Coated Rebar Ring
 - a) Reinforcing steel. Refer to Section 03211
 - (1) Use coated steel
 - (2) Refer to BA 5 Series Standard Drawings

- D. Cable Barrier/W-beam Guardrail Attachment Assembly – Single Sided and Double Sided assemblies. Refer to BA 5 Series Standard Drawings.
 - 1. Cable to W-beam Guardrail attachment rail
 - a. Furnish 10 gauge W-beam guardrail cable attachment rails according to cable manufacturer's requirements.
 - 1) Furnish attachment rail for use with existing W-beam guardrail installations.
 - b. Furnish hardware according to manufacturer's requirements to make cable to rail attachment.
 - c. Furnish 12 gauge W-beam guardrail elements for use with W-beam guardrail median barrier when required by plan set.
 - d. Refer to Section 02841 for W-beam guardrail, post, blocks and hardware requirements, except as noted in this Section, Article 2.2, paragraph E1.
 - 2. Cable posts must meet manufacturer's requirements for transitioning into W-beam guardrail cable attachment rail.
 - a. Delineation using AASHTO M 268 Type IX or greater.
- E. Cable/W-beam Guardrail Anchor Assembly – Single Sided and Double Sided assemblies. Refer to BA 5 Series Standard Drawings.
 - 1. W-beam Guardrail rail elements punched as shown on BA Series Standard Drawings. Typical posts, blocks, and hardware.
 - a. Refer to Section 02841.
 - 2. BCT cable anchor assembly, anchor plates, and bearing plates.
 - 3. Anchor post – Structural Steel. Refer to Section 05120.
 - a. I-Beam W 6 x 15, 3 ft long.
 - 1) Galvanize according to ASTM A 123.
 - b. Anchor Post Footing
 - 1) Concrete class AA(AE) – Refer to Section 03055.
 - 2) Reinforcement cage
 - a) Reinforcing steel – Refer to Section 03211.
 - (1) Use coated steel
 - (2) Install according to Standard Drawings.
- F. Cable Barrier Concrete Bridge Parapet Departure Bracket
 - 1. Refer to BA 5 Series Standard Drawings.
 - 2. Manufacture according to standard drawing.
 - 3. Steel as specified in ASTM A 709 Grade 36.
 - 4. Galvanize according to ASTM A 123, after fabrication.
 - a. Furnish specialty posts and all hardware for installations according to manufacturer's requirements.

- G. NCHRP-350 Cable Barrier Terminals
 - 1. Cable Barrier Terminal – NCHRP-350 Approved
 - a. Use a terminal the size and shape required by the manufacturer and meet manufacturer's specifications.
 - 1) Supply specialty posts as required for proper operation of terminal anchor.
 - b. Concrete foundation as required by manufacturer.
 - c. Object marker delineation using AASHTO M 268 Type IX or greater retroreflective sheeting.
 - d. Use on construction project required when existing cable has been removed on a temporary basis. Refer to Section 01554.
- H. Non-NCHRP 350 Cable Barrier End Anchor (deadman anchor)
 - 1. Additional barrier protection required for this end anchor.
 - a. See plan set for offsets and required external barrier protection.
 - b. Cable Barrier Anchor line posts with sleeve.
 - c. Concrete foundations as required by manufacturer.
- I. Delineation
 - 1. Sheeting Requirements
 - a. Refer to Section 02890
 - b. Application
 - 1) Cable Barrier/W Beam Anchor Systems – Refer to this Section, Article 3.7 paragraph A.
 - 2) Line Post – Refer to this Section, Article 3.7 paragraph B.
- J. High Tension Cable Gauge
 - 1. Furnish gauge capable of measuring cable tension during initial installation and for repairs.

PART 3 EXECUTION

3.1 PREPARATION

- A. Site Considerations
 - 1. Complete grading to final grade requirements according to the plan before installing cable barrier post foundations, terminals, transitions, W-beam components, and anchor systems.

2. Apply a bare-ground treatment, 2 ft on each side of the cable system using bare ground herbicide.
 - a. Apply after cable barrier foundations have been installed and the excess material has been removed or graded into surrounding area.
 - b. Follow product-labeling requirements for selected product.
 - c. Apply herbicide at a rate of 10 lb/acre.
 - d. Have a license issued by the Utah Department of Agriculture for Right-of-Way application.

3.2 CONCRETE FOUNDATIONS REQUIREMENTS

A. Line Posts

1. Cast-in-place post foundation
 - a. Do not over excavate hole.
 - b. Install manufactures' required reinforcing steel.
 - c. Install post sleeve no greater than ½ inch above finished grade of foundation.
 - d. Fill the excavated hole with concrete. Dome concrete down from top of post sleeve to flush with finished grade. Refer to BA 5 Series Standard Drawings.
 - 1) Do not use a tubular concrete form for foundation casting.
 - 2) Post sleeve will be within ¾ inch alignment to the post on either side.
 - a) Sleeve alignment can be adjusted to meet placement requirements on a horizontal curve.
 - b) Meet manufacturer's requirements if supplied system uses offset posts.
 - 3) Install foundation in such a manner that the post will stand vertically and be no greater than ½ inch from plumb.
 - e. Allow concrete to cure a minimum of seven days and achieve 4,000 psi before installing cable.

B. Cast-in-place non-NCHRP 350 Cable Barrier Anchor (deadman anchor)

1. Install according to manufacturer's specification.
 - a. Excavate hole and form a cast-in-place anchor.
 - 1) Install reinforcing steel according to cable manufacturer's requirements.
 - 2) Install hardware according to cable manufacturer's requirements for cable attachment.
 - 3) Install so the top of the anchor block will be at the same grade and elevation as the three consecutive posts foundations approaching the anchor block.

- b. Place concrete and allow to cure a minimum of seven days or achieve 4,000 psi before connecting and tensioning cable.
- c. Backfill with excavated material. Compact material around the cast-in-place anchor block to a minimum of 95 percent of maximum laboratory density. Refer to Section 02056. Dispose of excess material by removal or grade into surrounding area.
 - 1) Install so that anchor block will not move greater than 3 inches toward the opposite cable anchor or terminal during tensioning or after tensioning has been completed. Remove and replace with a larger block or secure so that no additional decrease of cable tension occurs if anchor block moves greater than 3 inches.
- 2. Install anchor line posts with sleeves and hardware for cable attachment as required for anchor system according to manufacturer's specification.
 - a. Install foundations with post sleeves for anchor posts according to manufacturer's requirements.
 - 1) Follow the same installation procedure, use the same concrete material, and allow the same curing time as required in this Section, Article 3.2, paragraph B1b.

3.3 CABLE BARRIER/W-BEAM GUARDRAIL ATTACHMENT ASSEMBLY

- A. Install all components of cable barrier to W-beam barrier attachment rail according to Department and manufacturer specifications.
 - 1. Meet the specifications as required by manufacturer for W-beam guardrail elements.
 - a. Installation according to manufacturer and Department requirements.
 - b. Install cable/w beam attachment rail to existing posts and blocks as shown on plan set.
 - 1) Remove existing W-beam guardrail panel before installation.
 - a) W-beam guardrail panels that are being reinstalled may be cut in an approved method.
 - b) Do not use a cutting torch on a panel that is to be reinstalled.

3.4 CABLE/W-BEAM GUARDRAIL ANCHOR ASSEMBLY

- A. Install W-beam guardrail or median barrier guardrail and cable/w-beam guardrail anchor assembly according to BA Series Standard Drawings.

3.5 CABLE BARRIER PARAPET DEPARTURE BRACKET

- A. Install bracket according to BA 5 Series Standard Drawings.
 - 1. Core drill 1½ inch holes into parapet at specified locations.
 - 2. Use 1 inch diameter, high strength bolts, washers, and nuts according to ASTM A 325.
 - a. Length varies based on parapet width.
 - b. Do not use all-thread rod.
 - 3. Furnish all hardware required to make cable connection to cable bracket.
 - 4. Furnish specialty posts according to cable system manufacturer.
 - a. Furnish hardware for specialty posts.
 - b. Install specialty posts according to manufacturer's requirements.

3.6 POST AND CABLE INSTALLATION

- A. Install posts according to manufacturer's height requirements to provide proper cable height.
 - 1. Install sleeve cover.
- B. Install cable according to manufacturer's requirements.
- C. Tension immediately after initial installation to manufacturer's requirements.
 - 1. Recheck and adjust tension 5 days, 10 days, and 15 days after initial tensioning.
 - 2. Maintain tension log showing time, date, location, ambient temperature, and final tension reading signed by the person performing the tension reading.
 - 3. Give log to the Engineer after work is completed.
 - a. Include manufacturer's recommended tension chart.

3.7 DELINEATION

- A. Cable Barrier/W-beam Anchor Systems
 - 1. Install delineation on crash cushion or end treatment. Refer to CC Series Standard Drawings.
 - 2. Install delineation on W-beam rail elements. Refer to GW Series Standard Drawings.
- B. Line Posts
 - 1. Install appropriate sheeting on the first and last line post and as stated below.
 - a. 3 ft spacing – 1st line with a maximum 50 ft to next line post

- b. 5 ft spacing – 1st line and 10th line post with a maximum 50 ft between posts
- c. 10 ft spacing – 1st line post with a maximum 50 ft to next line post
 - 1) Adjustment of one post either way to obtain maximum sheeting exposure is acceptable.
- d. Sheeting color – White or yellow, color to correspond with the adjacent edge line.
- e. Install so that sheeting is on approach side of nearest lane of traffic.
 - 1) Medians width less than 25 ft and barrier system within 15 ft of any travel lane.
 - a) Install a minimum 10 in² on approach side of nearest lane of traffic.
 - b) Install a minimum 8 in² on backside side of nearest lane of traffic.
 - 2) Medians width greater than 25 ft.
 - a) Install a minimum 10 in² on approach side of nearest lane of traffic.
- 2. Location of sheeting – Refer to BA Series Standard Drawings.
 - a. Trinity Highway Products – CASS System
 - 1) Place on cable spacer blocks.
 - b. Gregory Industries – Safefence System
 - 1) Place on cable spreader blocks.
 - c. Brifen USA – Brifen Wire Rope Fence
 - 1) Place on post cap.

END OF SECTION

SECTION 02861

PRECAST RETAINING/NOISE WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast Noise Walls and Precast Retaining/Noise Walls.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02075: Geotextiles
- C. Section 03055: Portland Cement Concrete
- D. Section 03056: Self-Consolidating Concrete (SCC)
- E. Section 03152: Concrete Joint Control
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 03390: Concrete Curing
- H. Section 09981: Concrete Coating

1.3 REFERENCES

- A. AASHTO M 251: Plain and Laminated Elastomeric Bridge Bearings
- B. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
- C. ASTM D 1777: Thickness of Textile Materials
- D. ASTM D 6364: Determining Short-Term Compression Behavior of Geosynthetics
- E. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of lifting devices for review.
 - a. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
 - b. Include supporting engineering calculations.
- B. Samples of the specified surface texture architectural treatments for review before casting of the panels.
 - 1. Refer to the plans for the required surface texture architectural treatments.
- C. Casting and Shipping Schedules
 - 1. A tentative casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
 - 2. A tentative shipping schedule for information at least 14 calendar days before shipping precast elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Precast Panels and Posts
 - a. Concrete Class AA(AE) according to Section 03055 or Self-Consolidating Concrete (SCC) according to Section 03056.
 - 1) 28-day minimum compressive strength of 5,000 psi.
 - 2. Post Holes
 - a. Concrete Class B. Refer to Section 03055.
- B. Reinforcing Steel
 - 1. Coated – Refer to Section 03211.
- C. Welded Wire Fabric
 - 1. Coated – Refer to Section 03211.
- D. Form-Liner Materials
 - 1. Refer to SW Series Standard Drawings.
 - 2. Use a form-liner that produces uniform texture and patterns and releases the sculpted concrete surface without damage.
 - 3. Provide solid backing and form supports so that the form-liners remain in place during concrete placement.

4. Use a form release agent that meets the following:
 - a. A manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
 - b. A non-petroleum release agent meeting all EPA requirements.
 - c. A release agent that is not detrimental to concrete strength or durability and that does not impart color, tint, or texture to the finished product.
- E. Lifting Devices
 1. Use the number, type, and size necessary to lift the largest precast panel used on the project and tilt it from a horizontal position to a vertical position.
 2. Use a galvanized flush-type that does not project beyond the edge of the panels.
 3. Design for the shear factor of safety 2.66:1 for lifting from a flat position and a tension factor of safety 4:1 for lifting from a vertical position.
 4. Design for shear so that the panels can be lifted from either side.
 5. Provide waterproof caps.
- F. Free Draining Granular Backfill
 1. Refer to Section 02056.
- G. Elastomeric Bearing Pad
 1. Refer to AASHTO M 251.
 2. Use 60 durometer hardness (Shore A), Grade 3 elastomer.
- H. Backer Rod
 1. Refer to Section 03152.
- I. Construction Adhesive
 1. According to wall manufacturer's recommendation.
- J. Wood Shims
 1. Use any grade fir.
- K. Composite Drainage Material
 1. Use a two-layer geocomposite sheet drain consisting of drainage geotextile bonded to one side of a three-dimensional drainage core.
 - a. Drainage geotextile – Refer to Section 02075.
 - b. Drainage core:
 - 1) High strength rigid plastic.

- 2) Minimum compressive strength – 15,000 lbs/ft². Refer to ASTM D 1621 or ASTM D 6364.
- 3) Minimum thickness – 0.40 inches. Refer to ASTM D 1777.
- 4) Capable of multidirectional flow.

L. Drainage Geotextile

1. Refer to Section 02075.

M. Concrete Coating System

1. Water Repellent – Refer to Section 09981.
2. Tinted Concrete Sealer – Refer to Section 09981.

2.2 PRECAST NOISE AND RETAINING/NOISE WALLS

- A. Refer to SW Series Standard Drawings.

2.3 FABRICATION

- A. Use a Department pre-qualified supplier of precast concrete products according to the UDOT Quality Management Plan 505 - Precast/Prestressed Concrete Structures.

B. Precast Concrete Posts

1. Cast posts in metal forms. Cast pilasters in metal or wood forms.
2. Permanently mark each post with the date of casting and the post identification number supplied by the inspector.
 - a. Place markings in fresh concrete near the bottom of the post.
3. Apply water repellent according to Section 09981 before shipping.
 - a. Water repellent may be applied at the project site after installation when authorized by the Engineer.
4. Verify sides do not deviate from a straight line by more than 1/8 inch in 10 ft.
5. Replace posts that are not permanently marked.

C. Precast Concrete Panels

1. Cast the panels to dimensional tolerances according to Precast Concrete Institute (PCI) or National Precast Concrete Association (NPCA), and as shown.
 - a. Cast in metal forms.
 - b. Do not use coloring additives.
 - c. Achieve uniformity of appearance, color, texture, and pattern.
 - d. Produce a concrete panel with smooth, solid surfaces free of voids and air pockets.

2. Permanently mark each panel with the casting date and the panel identification number supplied by Engineer on the panel end near the top.
3. Provide the surface texture architectural treatment on both sides of noise panels as shown. Provide the surface texture architectural treatment as shown on the exposed side of retaining panels. Remove all residue from panel surfaces.
 - a. Use a concrete form-liner to achieve the specified concrete texture.
 - b. Provide panel faces that are free of joint marks, grain, and other obvious defects. Provide corners including false joints that are uniform, straight, and sharp.
4. Apply water repellent according to Section 09981 before shipping.
 - a. Water repellent may be applied at the project site after installation when authorized by the Engineer.
5. Replace panels that:
 - a. Do not match in contrast.
 - b. Are not permanently marked.
 - c. Show discoloration from release agents.
6. Use a single, full-height noise panel between posts for all noise walls. Use a single noise panel and a single retaining panel between posts for retaining/noise walls.
 - a. The noise and retaining panels may be cast as a single panel when there is less than 3 ft of soil provided that the portion of the panel retaining soil meets all retaining panel requirements.

D. Curing

1. Cure according to Section 03390.

2.4 QUALITY CONTROL

A. Precast Posts and Panels

1. Document all test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of casting
 - c. Concrete cylinder test results
 - d. Quantity of the used concrete and the batch printout
 - e. Form-stripping date and repairs if applicable
 - f. Location or number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period
 - h. Lifting device details, requirements, and inserts
 - i. Side deviation measurement for precast posts, refer to this Section, Article 2.15, paragraph B4.

PART 3 EXECUTION

3.1 DELIVERY, HANDLING, AND STORAGE

- A. Store units with adequate dunnage and bracing.
 - 1. Protect units to prevent contact with soil and staining.
 - 2. Prevent cracking, distortion, warping, and other physical damage.
- B. Place stored units so identification marks are clearly visible and units can be inspected.
- C. Place non-staining resilient spacers of even thickness between each unit.
- D. Support units during shipment on non-staining shock absorbing material.

3.2 POST HOLES

- A. Place edge of post holes no closer than 2 ft from underground utilities.

3.3 CONCRETE POSTS

- A. Set true to line and grade. Replace posts more than ¼ inch out of plumb in 10 ft of exposed length.
- B. Replace posts that do not adequately support or accept insertion of the precast panels.

3.4 PRECAST CONCRETE PANELS

- A. Refer to SW Series Standard Drawings.
- B. Set elevations in the field for the Engineer's observation. Stake elevations to the bottom of the bottom panel. Align as shown.
- C. Apply construction adhesive to wood shims and drive tightly into place. Locate as shown.
 - 1. Cut off shim flush with post face.
- D. Retaining Walls
 - 1. Elastomeric bearing pad
 - a. Attach to concrete posts using construction adhesive as shown.
 - b. Attach to top of retaining panel using construction adhesive as shown.

2. Composite Drainage Material
 - a. Place behind the retaining panels at each weep hole location.
 - b. Place the fabric side of the material against the fill.
 - 1) Extend the length of the material from the bottom of the retaining panel to the top of the fill.
 - c. Attach to panels using construction adhesive.
 - d. Follow manufacturer's recommendations.
3. Drainage Geotextile
 - a. Place around the back side of the posts as shown.
 - b. Extend the material from the bottom of the retaining panel to the top of the fill.
 - c. Attach to posts using construction adhesive.
 - d. Follow manufacturer's recommendations.
4. Free Draining Granular Backfill
 - a. Place and tamp down behind the retaining panels, between the posts to the fill height and length, and at the locations shown.

3.5 LIFTING DEVICES

- A. Place waterproof caps in the lifting devices after the panels are permanently placed.

3.6 CONCRETE COATING SYSTEM

- A. Apply tinted concrete sealer to exposed concrete surfaces of panels and posts after installation is complete and as shown. Refer to Section 09981.
- B. Coat concrete surfaces to 6 inches below finished grade.

END OF SECTION

SECTION 02890

RETROREFLECTIVE SHEETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Retroreflective sheeting materials for traffic signs and traffic control devices.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM D 4956: Retroreflective Sheeting for Traffic Control
- C. Code of Federal Regulations (CFR)
- D. Construction of Roads and Bridges on Federal Highway Projects FP-03

1.4 DEFINITIONS

- A. Retroreflective Sheeting
 - 1. Sheeting – The retroreflective or non-reflective material that comprises the background, legend (word messages and symbols), and border.
 - 2. Sheeting Components – The matched component products required for the manufacture of highway signs consist of the sheeting, cutout letters and borders, adhesives, inks, and overlay films. Failure of the sheeting inks or overlay films, provided, sold, or recommended for use, constitute a failure of the entire sign and replacement under manufacturer's warranty replacement obligations. All components and warranties will be compatible with substrates used by the Department, including Aluminum ASTM B 209 5052 - H 38 or 6061-T6.
 - 3. Permanent Signs - Include sign installations that are in their final configuration and that are expected to have a multi-year life. Examples include freeway guide signs, regulatory signs, warning signs, barrier markers, crash cushion markers, and delineation.

4. Work Zone Standard Signs – MUTCD and Department standard application signs including but not limited to Road Work Ahead, Work Zone Speed Limit, Flagger Symbols, Business Access, and Regulatory signing within the work zone.
5. Work Zone Project Specific Signs – Signs that have legends specific to the project and that cannot be reused on a future project. Examples include: “Alder Street closed from 1st to 2nd Avenue – use Birch Street” or project notification signs. These are typically used for only one construction season.
6. Flexible Work Zone Devices – Include such devices as roll up signs, cones, tall cones, and flags with retroreflective sheeting.
7. Work Zone Channelization Devices – Include such devices as drums, vertical panels, barricades, tubular markers, and pavement marking tabs.

1.5 SUBMITTALS

- A. Manufacturer's Product Data and Specifications.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Retroreflective Sheeting
 1. Meet Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-03.
 2. Conform to 23 CFR 655 Subpart F for Standard Highway Colors for Ordinary and Fluorescent Sheeting.
 3. Meet ASTM D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control.
- B. Non-reflective Sheeting – As specified and according to the recommendation of the retroreflective sheeting manufacturer.
- C. Use matched component cutout legends, symbols, and borders.
- D. Use only acrylic EC film to achieve color. Do not use vinyl EC film to achieve color.

2.2 PERMANENT APPLICATIONS

- A. Traffic Signs and Traffic Control Devices
 1. Meet or exceed the minimum requirements of ASTM Type XI.
 2. Use fluorescent sheeting for orange, yellow and yellow-green.

- B. Miscellaneous Signs
 - 1. Use ASTM Type I for Adopt a Highway and Sponsor a Highway signs.
 - 2. Use ASTM Type I for Memorial signs.
 - 3. Use fluorescent pink retroreflective sheeting for Traffic Incident Management Area signs.

2.3 WORK ZONE APPLICATIONS

- A. Work Zone Signing
 - 1. Standard signs
 - a. Meet or exceed the minimum requirements of ASTM Type XI.
 - b. Use fluorescent retroreflective sheeting for orange, yellow, and yellow-green.
 - 2. Project specific signs
 - a. Meet or exceed the minimum requirements of ASTM Type III high intensity prismatic sheeting.
 - b. Use fluorescent retroreflective sheeting for orange, yellow, and yellow-green.
 - 3. Traffic incident management area signs
 - a. Use fluorescent pink.
- B. Flexible signs, cones, tall cones, and sign flags
 - 1. Use ASTM Type VI with minimum Coefficient of Retroreflection as shown in Table 1.

Table 1

Coefficient of Retroreflection (Candelas/Lux/Square Meter)						
Observation Angle	Entrance Angle	White	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange	Fluorescent Pink
0.2°	– 4°	500	400	300	200	180
0.2°	+ 30°	200	160	120	80	72
0.5°	– 4°	225	180	135	90	80
0.5°	+ 30°	85	68	51	34	30
1.0°	– 4°	50	40	30	20	18
1.0°	+ 30°	20	16	12	8	7

- C. Channelization Devices
 - 1. Vertical panels, barricade Types I, II, and III, and directional indicator barricades.
 - a. Meet or exceed the minimum requirements of ASTM Type XI.
 - b. Use of standard orange acceptable.
 - 2. Meet or exceed the minimum requirements of ASTM Type V for temporary raised pavement markers.

3. Meet or exceed the minimum requirements of ASTM Type IV with the minimum requirements of the Coefficient of Retroreflection as shown in Table 2 and the minimum requirements of the Color Specification Limits (daytime) of Table 3 for all other channelization devices.

Table 2

Coefficient of Retroreflection (Candelas/Lux/Square Meter)			
Observation Angle	Entrance Angle	White	Fluorescent Orange
0.2°	– 4°	335	135
0.2°	+ 30°	200	80
0.5°	– 4°	95	30
0.5°	+ 30°	65	25
1.0°	– 4°	12	4
1.0°	+ 30°	7	3

Table 3

Color Specification Limits (daytime)										
Color	Chromaticity Coordinates								Luminance Factor (Y%)	
	1		2		3		4			
	x	y	X	Y	x	Y	x	y	Min	Max
White	0.303	0.306	0.368	.0366	0.340	0.393	0.274	0.329	27	--
Fluorescent Orange	0.645	0.355	0.562	0.348	0.506	0.404	0.570	0.429	20	

4. Use fluorescent retroreflective sheeting for orange and yellow.
5. Do not obscure retroreflective sheeting with paint or other materials.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not reverse screen sign larger than 7 ft²/color.
- B. Establish proper orientation of the sheeting for all traffic signs and traffic control devices.
 1. Verify cutout legends, symbols, and borders have the same sheeting orientation as background sheeting.

3.2 INSTALLATION

- A. Permanent sign and sheeting identification
 - 1. Affix to each sign a 1 inch high, two-digit number representing the fabrication year to the front lower left corner of each sign. Use numbers of contrasting color to sheeting color. Represent the year 2012 as "12", and so forth.
 - 2. Affix to each sign a 2 inch x 2 inch impermeable, non-fading weather-resistant, self-adhesive label. Attach label where it will not obscure sheeting. The label contains the month and year of manufacture, Contractor's name, and type of sheeting.

END OF SECTION

SECTION 02891
TRAFFIC SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ground mounted roadside traffic signs, including supports and foundations.
- B. Traffic signs for overhead sign structures.

1.2 RELATED SECTIONS

- A. Section 01721: Survey
- B. Section 02317: Structural Excavation
- C. Section 02890: Retroreflective Sheeting
- D. Section 02894: Precast Roadside Sign Foundations
- E. Section 03055: Portland Cement Concrete
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 05120: Structural Steel

1.3 REFERENCES

- A. ASTM A 123 / A 123M: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A 513: Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
- C. ASTM A 653: Steel, Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by Hot-Dip Process
- D. ASTM A 787: Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
- E. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate

F. American Plywood Association (APA) Product Standard

1.4 DEFINITIONS

A. Traffic Sign Components

1. Panel – Assembly of substrate and attached sheeting. Several panels may be necessary to complete one sign. Panel types are:
 - a. Type
 - 1) A: Retroreflective sheeting on sheet aluminum
 - 2) PW: Retroreflective sheeting on plywood-backed sheet aluminum
 - b. Legend
 - 1) Non-reflective legend and border
 - 2) Retroreflective legend and border
2. Panel Overlay – Attaching new panels to all or part of an existing panel.
3. Panel Replacement – Removing the existing panel and attaching a new panel to the frame.
4. Sheeting – The retroreflective or non-reflective material that comprises the background, legend (word messages and symbols), and border.
5. Sheeting Components –All components and warranties will be compatible with substrate used by the Department, Aluminum ASTM B 209 5052 - H 38 or 6061-T6.
6. Sign – An assembly comprised of panel, panel with frame when required, panel with “Z” bar when required.
7. Size – Width x Height.
8. Substrate – The base aluminum material, to which the background sheeting is attached.

1.5 SUBMITTALS

- A. Manufacturer’s product data sheets and installation instructions.

1.6 SIGN CODES

A.	New Sign	N
B.	Relocation	R
C.	Removal	X
D.	Panel Replacement	PR
E.	Panel Overlay	PO

Traffic Signs
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PART 2 PRODUCTS

2.1 MATERIALS

- A. Fabricate according to SN Series Standard Drawings.
- B. Substrate Aluminum – 0.080 or 0.125 inch thick as follows. Refer to ASTM B 209 alloy 6061-T6, or 5052-H38.
 - 1. Use 0.125 for signs installed on frame and Gore signs.
 - 2. Use 0.080 for all other signs.
- C. Plywood Backing – According to APA product standard PS 1-83, Group One: ½ inch thick.
 - 1. 30/30, high density BB exterior (Douglas Fir) B Grade.
 - 2. Plugged-core (Douglas Fir) with ½ inch maximum gaps.
- D. Bases – According to SN Series Standard Drawings
- E. Posts, “T” and “U” brackets, extensions, and hardware according to SN Series Standard Drawings.
 - 1. Posts
 - a. Refer to ASTM A 513 or ASTM A 787
 - b. Galvanize according to ASTM A 653 or ASTM A 123
 - 2. “T” and “U” Extension and 90 degree Post Extension
 - a. Galvanize according to ASTM A 653 or ASTM A 123
 - 3. S Section and W Section steel posts
 - a. Structural Steel: Refer to Section 05120
- F. Retroreflective and non-reflective sheeting – Refer to Section 02890.
- G. Sheeting Components - The matched component products required for the manufacture of highway signs will consist of the sheeting, cutout letters and borders, adhesives, inks, and overlay films.
 - 1. Failure of the sheeting inks or overlay films, provided, sold, or recommended for use, will constitute a failure of the entire sign and be replaced under manufacturer’s warranty replacement obligations.
- H. Fasteners for ground mounted signs – Refer to applicable SN Series Standard Drawings.

- I. Foundation for ground mounted signs – Refer to applicable SN Series Standard Drawings.
 - 1. Precast foundation – Refer to Section 02894.
 - 2. Concrete – Class AA(AE) or B(AE). Refer to Section 03055. Use Concrete Class B(AE).
 - a. A commercially available product that meets or exceeds 4,000 psi or a concrete mix meeting Section 03055 Concrete Class B may be used for project totals requiring one cubic yard or less.
 - 1) Mix before placing.
 - 3. Reinforcing steel – Refer to Section 03211.
 - 4. Anchor bolts - Refer to section 05120.
- J. Structural steel for ground mounted signs– Structural steel frame, attachments, fasteners. Refer to Section 05120.

PART 3 EXECUTION

3.1 PREPARATION

- A. Excavate – Refer to Section 02317.

3.2 INSTALLATION – GENERAL

- A. Do not reverse screen sign larger than 7 ft²/color.
- B. Do not remove a sign that is being replaced until the new sign is placed and uncovered.
- C. Compact backfill to a density equal to surrounding materials.
- D. Establish proper elevation and orientation of all signs and structures and determine proper sign post lengths as dictated by construction slopes. Refer to SN Series Standard Drawings.
- E. Cover signs that require temporary covering with an opaque material. Secure at the rear of the sign so that the sign is not damaged.
 - 1. Maintain covering until covering or sign is removed.
- F. Construct sign post foundations with concrete according to dimensions.
- G. Affix a 1 inch high two-digit numeral representing the fabrication year to the front lower left corner of each sign. Make numbers a contrasting color to sheeting color. Represent the year 2017 as “17” and so forth. Refer to Section 02890.

- H. Affix to each sign a 2 inch x 2 inch impermeable, non-fading weather-resistant, self-adhesive label.
 - 1. Label includes the month and year of manufacture, Contractor's name, and type of sheeting. Attach label where it will not obscure sheeting. Refer to Section 02890.

3.3 RELOCATE EXISTING SIGN

- A. Remove existing foundations to a minimum of 6 inches below the ground line and backfill.
- B. Provide and install new posts and accessories as required.
- C. Retrofit as required to meet current standards.

3.4 REMOVE EXISTING SIGN

- A. Remove foundations to a minimum of 6 inches below the ground line and backfill.

3.5 RELOCATE EXISTING MILEPOST SIGN

- A. Survey location of existing milepost signs as specified in Section 01721 before removal.
- B. Milepost sign may be removed and stored to facilitate project work.
- C. Comply with other requirements listed in this Section, Article 3.3.
- D. Reestablish milepost sign at location according to Section 01721.

END OF SECTION

SECTION 02892

TRAFFIC SIGNAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Traffic signals and supports.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02890: Retroreflective Sheeting
- C. Section 02891: Traffic Signs
- D. Section 03055: Portland Cement Concrete
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 03310: Structural Concrete
- G. Section 03575: Flowable Fill
- H. Section 13594: Fiber Optic Communication
- I. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO Roadside Design Guide
- B. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals
- C. ASTM D 3005: Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- D. ASTM D 3035: Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- E. American Iron and Steel Institute (AISI)

- F. American National Standards Institute (ANSI)
- G. American Wire Gauge (AWG)
- H. International Municipal Signal Association (IMSA) Standards
- I. National Electrical Code (NEC)
- J. National Electrical Manufacturers Association (NEMA)
- K. Underwriters Laboratory (UL)

1.4 DEFINITIONS

- A. Powder Coat – Coating of metals applied to provide coloration.

1.5 SUBMITTALS

- A. Submit the following before beginning signal work:
 - 1. Certification for the Licensed Journeyman or Master Electrician who will be responsible for and supervise on-site electrical work.
 - a. Journeyman or Master Electrician License
 - b. List of experience demonstrating the required 3 years of experience in traffic signal construction.
 - 2. Certification documents for at least two IMSA Traffic Signal Field Level II certified technicians or Department approved equivalent.
- B. Submit the following no more than 15 days after beginning signal work:
 - 1. List of equipment and materials including manufacturer name, size, and identification number.
 - 2. Detailed shop drawings, wiring diagrams, and certifications.
 - 3. Manufacturers' warranties, guarantees, instruction sheets, and part lists.
- C. A warranty letter to the Engineer stating that the Contractor guarantees the Contractor furnished electrical and mechanical equipment free from defects for a period of 6 months.
 - 1. The guarantee period starts on the date of physical completion.
 - 2. Include in a letter:
 - a. State Project Designation
 - b. State Project Name
 - c. Contractor, Provider, and Installer Name
 - 3. The guarantee covers 100 percent of the Contractor furnished electrical and mechanical equipment costs.
 - 4. Remove and replace all Contractor furnished electrical and mechanical equipment that is defective.

5. The Department will notify the Contactor of defects to be repaired during the guarantee period.
 - a. Submit detailed plans and procedures of corrective work according to Providers recommendations and obtain the Department's acceptance before commencing work.
 - b. Perform corrective work within 30 days of notification.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use electrical components as listed and defined by the NEC.
- B. Refer to SL Series Standard Drawings.

2.2 STATE FURNISHED MATERIALS

- A. State Furnished Materials include:
 1. Anchor bolts
 2. Traffic signal poles
 3. Mast arms
 4. Luminaire poles and extensions
 5. Radar detector equipment
 6. Traffic signal head assembly
 7. LED signal modules
 8. Back plate and tape
 9. Visors
 10. Signal head mounting brackets
 11. LED luminaires
 12. Cabinets (excludes pole mounted cabinets)
 13. Controllers
 14. Related hardware

2.3 WIRING

- A. Power Service/Lighting Conductors
 1. Refer to Section 16530
 2. Stranded copper conductors only
 3. Continuous red insulation color for AC+
 4. Continuous white insulation color for neutral
 5. Conductors sized per NEC (minimum #10 AWG RHH RHW-2, XLP USE-2 or approved equivalent)

- B. Signal Cable
 - 1. 4- and 7-conductor cables
 - 2. 14 AWG copper conductors only
 - 3. Multi-colored stranded cables
 - 4. Meets IMSA 20-1 specification
- C. Bonding/Grounding System
 - 1. Refer to Section 16530.
- D. Radar Detection Cable
 - 1. Use manufacturer recommended cable for the length of the installation.
- E. Advanced Warning Signal (AWS) System Cable
 - 1. 4-conductor cables
 - 2. 14 AWG multi-colored stranded copper conductors only
 - 3. Meets IMSA 20-1 specification

2.4 TEMPORARY SIGNAL HEAD COVER

- A. Heavy duty nylon or canvas, designed to completely cover all faces, visors, and back plates.
 - 1. Prevent indications and tape from shining through at night.

2.5 PEDESTRIAN SIGNAL HEAD

- A. Refer to SL Series Standard Drawings.
- B. Provide countdown pedestrian signal assembly with a gloss black colored polycarbonate housing and clear flat LED signal module.
- C. LED pedestrian countdown module will not require special tools for installation and will fit into a 16 inch x 18 inch traffic signal housing.
 - 1. The module will be rated for use in the ambient operation temperature range of -40 degrees F to +165 degrees F and will be completely sealed against dust and moisture intrusion.
 - 2. The message will consist of a double overlay message combining the graphic symbols of a hand and walking man and two, seven segment digits.
 - 3. The hand and man symbols will be no less than 10 inches high.
 - 4. The countdown digits will be no less than 9 inches high.
- D. Terminal block will consist of dual wiring, screw terminal and quick disconnect features for the neutral walk and don't walk phase.

- E. Use $\frac{3}{4}$ inch wide by 0.03 inch thick AISI type 201 stainless steel pole mount bands.
 - 1. Clamshell will be a two-part mounting assembly with stainless steel hinge pins on the pole-mounted half.
 - 2. The two halves will be secured together with a stainless steel flat head socket bolt requiring a $\frac{3}{16}$ inch Allen wrench.
 - 3. The assembly will be interchangeable left to right mount.

2.6 PEDESTRIAN PUSH BUTTON ASSEMBLY

- A. Refer to SL Series Standard Drawings.
- B. Pedestrian Push Button with LED Indicator
 - 1. Pedestrian button with standard 4 bolt circle.
 - 2. ADA compliant assembly with a 2 inch diameter stainless steel actuator.
 - 3. Assembly with solid state electronic Piezo switch with no moving plunger or moving electrical contacts.
 - 4. Enclose supporting circuitry within the button with wiring to the push button terminated on two screw terminals.
 - 5. Rain tight gasket to seal between the button assembly and the frame.
 - 6. Button that gives indications to the user that a call has been made in both of the following forms:
 - a. Audible beep when button is pushed.
 - b. Momentary LED light as the button is pushed, or LED light that stays on for 3 to 5 seconds if the button is pushed and held closed, or an LED light that stays on until the pedestrian signal phase is activated.
 - 7. Minimum 5-year unlimited warranty.
- C. Pedestrian Push Button Frame
 - 1. Provide cast aluminum frame, powder coated black, capable of supporting push button and a 9 inch x 12 inch sign, with the following characteristics:
 - a. Frame attaches to the pole using two ANSI $\frac{1}{4}$ -20 x $1\frac{1}{2}$ inch hex head or Phillips brass bolts attached behind the sign.
 - b. Frame is additionally supported using adjustable staves.
 - c. Sign attaches above the button using ANSI 8-32 stainless steel Allen head screws.
 - d. Cable guide extends through a $\frac{7}{8}$ inch diameter mounting hole in the support pole to channel wiring to the button.
 - 2. Provide push button frame standoff brackets to mount two frames perpendicular on one pedestrian signal pole.
 - a. A single piece solid aluminum or stainless steel bracket designed for various pole diameters.

- b. No additional holes required for mounting.
- D. Pedestrian Push Button Sign
 - 1. Provide a 9 inch x 12 inch sign with corner radii that allow the sign to fit completely within the frame.
 - 2. Provide specified two-sided push button sign, one side of the sign with a right pointing finger and arrow and the other side of the sign with a left pointing finger and arrow.
 - 3. Provide sign fabricated from substrate aluminum with retroreflective sheeting. Refer to Section 02891 for aluminum substrate and Section 02890 for retroreflective sheeting. Provide standard ANSI 8-32 clearance holes or eyelets for mounting.

2.7 CONDUIT

- A. Refer to SL Series Standard Drawings.
- B. Meet or exceed all of the conduit manufacturer's recommendations for materials used in the installation of conduits including sweeps, adapters, couplings, glue, plugs, duct seal, and fittings.
- C. Conduit and Fittings
 - 1. Minimum schedule 40 PVC rated at 194 degrees F as specified in NEMA TC-2, NEMA TC-3, ASTM D 3005, UL Listed.
 - 2. High Density Polyethylene (HDPE) SDR11 rated as specified in ASTM D 3035 with ribbed or smooth interior.
 - 3. Rigid steel as specified in UL-6. Galvanized as specified in ANSI C80.1.
 - 4. Flexible watertight conduit and fittings as specified.
 - 5. Use only pushlock style coupling for connection of HDPE conduit to PVC conduit. Glued fittings will not be accepted.
 - 6. Sweeps – factory manufactured sweeps complete with bell and spigot.
- D. Duct Seal - At least 2 inches of duct seal to seal the conduit and allow the secure fastening of detectable pull tape.
- E. Detectable Pull Tape – flat profile, low stretch polyester, detectable, sequential footage marked, 1,200 lb tensile strength pull tape in each conduit.
- F. Backfill
 - 1. Flowable Fill - Refer to Section 03575.
 - 2. Free Draining Granular Backfill Borrow – Refer to Section 02056.
 - 3. Native material – Compact to match existing conditions.

- 4. Sand
 - a. Friable natural aggregate, free of loam, detrimental, soluble, or organic matter
 - b. 3/8 inch minus, well graded

2.8 JUNCTION BOXES

- A. Refer to SL Series Standard Drawings.
- B. Polymer Composite or Polymer Concrete Junction Box
 - 1. Polymer concrete ring
 - a. Fused with composite body
 - b. UV and chemical resistant

2.9 POWER SOURCE AND GROUNDING

- A. Refer to SL Series Standard Drawings.
- B. Refer to Section 16530.
- C. Ground Rod Clamps – Acorn with split bolt attachment for each additional wire.

2.10 POLE MOUNTED SIGNAL CABINET

- A. Refer to SL Series Standard Drawings.
- B. NEMA 3R cabinet
 - 1. Sized to adequately house all necessary signal equipment.
 - 2. Fastened to pole with 3/4 inch by .03 inch thick AISI Type 201 stainless steel bands.
 - 3. All connections watertight.
 - 4. Standard Corbin #2 lock assembly.

2.11 MOUNTING BANDS AND BUCKLES

- A. Refer to SL Series Standard Drawings.
- B. 3/4 inch wide by 0.03 inch thick AISI Type 201 stainless steel.

2.12 MAST ARM SIGNS AND SIGN MOUNTS

- A. Refer to SL and SN Series Standard Drawings.
- B. Refer to Section 02891.

- C. Sign Mounting Bracket
 - 1. Pelco Astro Sign-Brac, Cable Mount for Overhead Street Name Signs or approved equivalent.
 - 2. Stainless steel sign clamps.

2.13 POLE FOUNDATION

- A. Drilled Shafts. Refer to Section 02466
 - 1. Use Class AA(AE) concrete according to Section 03055.
 - 2. Use coated deformed reinforcing steel according to Section 03211.
- B. Sand and Cement Dry Pack Grout
 - 1. Minimum Strength – 50 psi
 - 2. Maximum Strength – 150 psi
 - 3. Slump – 5 inches to 10 inches

2.14 PREEMPTION

- A. Emergency Vehicle Preemption (EVP)
 - 1. Contractor provided materials.
 - 2. Equipment make and model to be specified by the project plans or the local Municipality or Fire Department.
- B. Railroad (RR) Preemption
 - 1. Contractor provided materials.
 - 2. 7-conductor signal cable, according to Article 2.3, Paragraph B of this Section.

PART 3 EXECUTION

3.1 QUALIFIED PERSONNEL

- A. All electrical work must be supervised by a Master or Journeyman electrician. All traffic signal work must be supervised on site or completed by IMSA level II certified personnel or Department approved equivalent.
 - 1. Provide at least one level II IMSA certified personnel on site. With crews of five or more, provide at least two level II IMSA certified personnel.
 - 2. Failure to demonstrate compliance will result in a stop work order until current certifications can be met.
 - a. Payment of items related to this section may be withheld for any work not meeting this requirement.

3. The Department may declare the Contractor to be in default and terminate the contract if certifications cannot be met within 10 calendar days of issuance of a stop order.
 - a. The prime Contractor is responsible for all incurred cost of the work performed by other forces.
- B. Contractors are not allowed to turn on a traffic signal.
 1. Only personnel approved by the Department are permitted to turn on traffic signals.

3.2 PREPARATION

- A. Coordinate Department Furnished Materials
 1. Receive materials at the Department's Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse by calling (801) 965-4060 to schedule a pickup, at least 48 hours in advance.
 2. Receive drop shipment materials at the prearranged location.
 3. Powder Coated Materials
 - a. Deliver Department furnished materials for powder coating from the Department's Central Warehouse to the powder coating facility.
 - b. Deliver Department furnished materials from the powder coating facility to the project site.
 - c. Paint to match hardware attached to powder coated items such as signal pole caps, bolts, and hand hole covers.
 - d. Powder coat base plate adapters to match signal poles.
- B. Notify the Engineer and local traffic enforcement agencies at least 5 working days before any operational change or shutdown of a traffic signal system.
- C. Contact local power utility at least 30 days before the connection date. Verify the exact location, voltage, procedure, and materials required by the local power utility.

3.3 EXISTING FACILITIES

- A. Maintain and work around existing traffic signal equipment until the new or modified traffic signal system has been installed and is operational when existing traffic signal installations are modified or completely rebuilt.
 1. Use temporary signal head covers on signal heads and back plates that are not in operation.
 2. Do not disconnect or remove an existing signal system until the replacement system is fully functioning.

3. Replace an existing signal damaged during construction within 48 hours.
- B. Obtain approval before removal of operating detection equipment.
 1. Notify Engineer at least 48 hours before removal.
 2. Engineer may enforce liquidated damages if system is taken out of service without approval.
- C. Remove and replace the entire concrete slab to the nearest joints if a portion of a slab is broken or damaged during construction.
- D. A uniformed police officer must be on-site during a signal change over.

3.4 UTILITY CONFLICTS AND OBSTRUCTIONS

- A. Modify proposed equipment locations to avoid conflict with underground utilities or other obstructions as required.
 1. Obtain approval from the Engineer before modifying locations.
- B. Coordinate with the Engineer to field-locate new facilities such as cabinet foundations, camera poles, detector poles, and junction boxes.
- C. Field locate equipment with the Engineer:
 1. Avoid areas with poor drainage or high potential impact from thrown snow.
 2. Place for maximum accessibility and safety for maintenance personnel and vehicles, including a bucket truck.
 3. Satisfy clear zone requirements as defined in the AASHTO Roadside Design Guide. Verify right of way limits are not exceeded.
 4. Satisfy requirements of applicable UDOT Standard Drawings.

3.5 EXCAVATION

- A. Move the excavated material to a location that will minimize obstructions to pedestrian or vehicular traffic, and will not interfere with surface drainage.
- B. Protect pedestrian and vehicular traffic from excavation.
- C. Remove and properly dispose of surplus excavated material within 48 hours.
- D. Do not backfill conduit trenches until inspected by the Engineer.

3.6 TEMPORARY SIGNALS

- A. Maintain at least two signal heads for the primary movement at a signalized intersection on all approaches.
- B. Temporary equipment must meet current specifications unless approved by the Engineer.

3.7 TEMPORARY POWER

- A. Generators used to provide power to a traffic signal must be equipped with an inverter.

3.8 FACILITIES TAKEN OUT OF SERVICE

- A. Existing conduits remain in place.
- B. Remove conductors taken out of service.
 - 1. Cut conductors, wires, and cables at the end of the conduit if they cannot be removed due to conduit damage.

3.9 REMOVE AND SALVAGE EXISTING EQUIPMENT

- A. Existing traffic signal equipment remains the property of the Department.
- B. Verify that the Salvage Existing Equipment Checklist has been placed in the signal cabinet by the Department signal crew before construction.
- C. Replace in kind equipment damaged during the removal or transport process. Equipment will be returned within 72 hours of removal to the region signal office.
- D. Remove foundations to a depth of at least 12 inches below the existing surface.
- E. Remove and properly dispose of abandoned junction boxes.
- F. Backfill holes with local material, compact to the density of the surrounding area, and cap with surrounding material.
 - 1. Cap with concrete at least 4 inch thick and finish to match surrounding grade if located in pavement.

3.10 CONSTRUCT POLE FOUNDATION

- A. Refer to SL Series Standard Drawings.

- B. Reinforcing Steel and Welded Wire. Refer to Section 03211
- C. Do not weld reinforcing steel, anchor bolts, or conduit.
 - 1. Use tie wire to secure conduit.
 - 2. Use template to align and secure drop in anchors.
- D. Do not mount steel on foundations until they have been placed for at least 7 days or attained 75 percent of the specified 28-day compressive strength based upon field cured cylinders.
- E. Place and hold anchor bolts in proper alignment, position, and height before and during concrete placing and vibrating.
- F. Install anchor bolts according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals Article 5.17.
 - 1. Retighten all nuts after the structure is fully loaded.

3.11 CABINET BASE AND CABINET INSTALLATION

- A. Refer to SL Series Standard Drawings.

3.12 SIGNAL POLE AND MAST ARM PLACEMENT

- A. Install signal pole to be plumb after mast arm is attached.
 - 1. Rake pole to level mast arm.
 - 2. Do not rake the signal pole to increase signal head clearance.
- B. Tighten anchor bolt nuts on signal poles to snug tight plus $\frac{1}{3}$ turn.
- C. Tighten anchor bolt nuts as shown on SL Series Standard Drawings for poles with breakaway slip base systems.
- D. Field assemble multi-section mast arm slip joints to achieve a snug fit.
 - 1. Apply anti-seize compound and provide overlap not less than $1\frac{1}{2}$ times inside diameter of end section.

3.13 DIRECTIONAL BORING AND TRENCHING FOR CONDUIT

- A. Directional Boring
 - 1. Use directional boring for conduit installation on roadway crossings unless otherwise approved.

- B. Trenching Paved Surface
 - 1. Do not trench through paved surface without approval from the Engineer.
 - 2. Maximum trench width: 6 inches.
 - 3. Use flowable fill to bottom of pavement or to within 3 inches of the roadway surface when pavement is less than 3 inches thick.
 - 4. Apply tack coat evenly before final backfill when surface is asphalt.
 - 5. Match the composition, density, and elevation ($\pm \frac{3}{16}$ inch) of the existing pavement section.
- C. Trenching Unpaved Surface
 - 1. Use backfill that matches the composition, density, and elevation of the existing surface.
 - 2. Install conduits that pass under finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by jacking, drilling, or pushing.
- D. Minimum Conduit Cover
 - 1. Refer to SL Series Standard Drawings.

3.14 INSTALL CONDUIT

- A. Place all conduits in the same trench before surfacing.
- B. Use PVC or HDPE conduit underground as shown.
- C. Seal uncapped conduit ends inside junction box with at least 2 inches of duct seal.
- D. Do not use a torch for bending or shaping PVC conduit.
 - 1. Use equipment specifically designed to heat PVC conduit to shape required curves or radii.
- E. Do not exceed 270 degrees of conduit sweeps between junction boxes.

3.15 INSTALL JUNCTION BOX

- A. Refer to SL Series Standard Drawings.
- B. Provide at least 10-inch spacing between adjacent junction boxes.

3.16 INSTALL WIRING

- A. Conductors
 - 1. Clean and dry the inside of the conduit before installing conductors and cables.
 - 2. Install grounding conductor in circuit conduits with 50 V or higher voltage.
 - 3. Use approved lubricants when pulling conductors and cables in conduit.
 - 4. Pull conductors and cables with pull tape.
 - 5. Tape the ends of unused conductors and label them as spares.
 - 6. Land wires according to SL Series Standard Drawings.
- B. Bonding Conductor (Ground)
 - 1. Size bonding wire according to NEC article 250 (minimum #8 AWG, solid insulated).
 - a. Run continuously and bond to each metal signal pole or luminaire pole.
 - 2. Bond the grounding system conductor to the ground rod in each junction box except in circuits with less than 50 V.
 - 3. A concrete encased electrode may be used according to NEC 250 in signal pole foundations as an alternative to a ground rod in case of excessive rocky soil conditions if approved by the Engineer.
 - a. Do not place the concrete until Department conducts a pre-pour inspection of the electrode.
- C. Arrange the wiring neatly within enclosures such as cabinets, junction boxes, and fixtures.
 - 1. Provide at least 6 ft of slack cable (for all cables) at every junction box that cable passes through.
 - 2. Provide at least 25 ft of slack cable at the nearest junction box for cables connecting to pedestrian signal poles.
- D. Terminate terminal connections with a mechanical (spade) connector.
- E. Provide a separate 7-conductor cable for signal heads that control a dedicated turn phase.
- F. NEC requires no more than 40 percent of conduit be filled with cables. In cases where more cable is required conduit size or quantity may be increased for that specific crossing.

- G. Mark cabinet cables with colored vinyl electrical tape as specified in Table 1.

Table 1

Cables Marked with Colored Tape				
	Northbound	Southbound	Eastbound	Westbound
Signal Circuit	Blue	Red	Yellow	Orange
Detector Circuit	Blue	Red	Yellow	Orange
Circuit Coding	One band = Through, Two bands = Left Turn, Three bands = near side Detection: Stop Bar one, Advance two			
Pedestrian Head Circuit	Blue and Green	Red and Green	Yellow and Green	Orange and Green
Pedestrian Button Circuit	Blue	Red	Yellow	Orange
Ped Pole	Blue/white	Red/white	Yellow/white	Orange/white

3.17 INSTALL POWER SOURCE

- A. Refer to Section 16530 and SL Series Standard Drawings.

3.18 INSTALL LUMINAIRE

- A. Refer to SL Series Standard Drawings.

3.19 INSTALL SIGNAL HEAD

- A. Refer to SL Series Standard Drawings.
- B. Install optically-programmed vehicle signal heads according to the manufacturer's instructions.
- C. Install signal head so no more than half its height is above the center of the mast arm.
1. Standard signal head clearance heights must be met.

3.20 INSTALL PEDESTRIAN SIGNAL HEADS AND PUSH BUTTONS

- A. Refer to SL Series Standard Drawings.

3.21 INSTALL MAST ARM SIGN

- A. Attach mast arm sign with mounting brackets using stainless steel straps.

- B. Mount sign on mast arm so that the legend/message is horizontal even if on a curved section of mast arm.

3.22 INSTALL RADAR DETECTION

- A. Install, aim, and terminate radar detection 24 hours before signal turn-on. Contact the Engineer for assistance with detection area locating.

3.23 UDOT SIGNAL CHECKLIST

- A. Complete the UDOT Traffic Signal Turn-on Checklist before scheduling the in-progress signal inspection.
 - 1. Obtain checklist from the Engineer or online:
<http://www.udot.utah.gov/go/standardsreferences>
 - 2. Contact the Engineer to schedule the in-progress signal inspection with the Region Signal Supervisor at least 7 days before turn-on.
 - 3. Provide justification and obtain written acceptance from the Region Signal Supervisor for checklist items required before turn on not checked "Y".
 - 4. Notify the Engineer at least 5 days before signal turn-on.
 - 5. Turn-on is not considered complete until ATMS fiber optic communications are functional according to Section 13594.

3.24 TRAFFIC SIGNAL MAINTENANCE DURING CONSTRUCTION

- A. Maintenance and operation of traffic signals during construction is the responsibility of the contractor with all phasing or timing changes pre-approved by the Engineer.
- B. Provide emergency maintenance on a 7-day per week, 24 hour basis until substantial completion of the project.
 - 1. Respond within 15 minutes and be on-site within 30 minutes plus travel time when contacted by the dispatcher.
 - 2. Provide contacts and telephone numbers to the Engineer for the emergency service.
- C. Initiate other non-emergency repairs within 24 hours of notice.

3.25 INSTALL RAILROAD PREEMPTION

- A. Installation of a new signal within 500 ft of an at-grade railroad crossing requires coordination with the Engineer on how to address preemption.

- B. Install 7-conductor signal cable between the signal cabinet and the railroad signal house.
 - 1. Railroad signal house connections to be completed by the railroad owner.
- C. For existing signals with railroad preemption, coordination on preemption adjustments is required for any work which results in:
 - 1. Signal phasing or timing changes
 - 2. Geometric changes (widening)
 - 3. Rail crossing modifications

END OF SECTION

SECTION 02893

OVERHEAD SIGN/VMS STRUCTURE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for the fabrication and installation of overhead sign structure including anchor bolts, structural pipe, sign frame and brackets.
- B. Materials and procedures for the fabrication and installation of overhead VMS structure and catwalk including anchor bolts and structural pipe.

1.2 RELATED SECTIONS

- A. Section 05120: Structural Steel
- B. Section 09972: Painting for Structural Steel

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A 36: Carbon Structural Steel
- C. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- E. ASTM A 193: Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- F. ASTM A 194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, Or Both
- G. ASTM A 307: Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- H. ASTM A 370: Mechanical Testing of Steel Products

- I. ASTM A 436: Austenitic Gray Iron Castings
- J. ASTM A 493: Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- K. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- L. ASTM A 563: Carbons and Alloy Steel Nuts
- M. ASTM A 595: Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use
- N. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- O. ASTM B 134: Brass Wire
- P. ASTM B 221: Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- Q. ASTM B 308: Aluminum-Alloy 6061-T6 Standard Structural Profiles
- R. ASTM B 429: Aluminum-Alloy Extruded Structural Pipe and Tube
- S. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- T. ASTM D 4066: Classification System for Nylon Injection and Extrusion Materials (PA)
- U. ASTM F 436: Hardened Steel Washers
- V. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs
- W. ASTM F 594: Stainless Steel Nuts
- X. ASTM F 844: Washers, Steel, Plain (Flat), Unhardened for General Use
- Y. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
- Z. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- AA. ASTM F 3125: High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

- BB. American Institute of Steel Construction (AISC)
- CC. American Petroleum Institute (API)
- DD. AWS D1.1 Structural Welding Code – Steel
- EE. AWS D1.2 Structural Welding Code – Aluminum
- FF. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS

- A. Snug Tight – The tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of all fabricated materials for review.
 - a. Include exact locations of all hand holes, threaded inserts, and shop splices.
 - b. Include sign frame drawings.
- B. Material submittals for information.
 - 1. Mill Test Report (MTR) for all structural steel and aluminum. Provide item number and name on all materials submittals. Refer to Section 05120.
 - 2. Manufacturer's certificate of compliance for nut proof load tests. Refer to Section 05120.
 - 3. Charpy V-Notch test results.
- C. Welding submittals for information
 - 1. Weld Procedure Specifications and Procedure Qualification Records according to AWS D1.1.
 - 2. Welders test reports for each operator, process, and position as required by AWS Specifications.
 - a. Include a letter from the Fabricator that states the certified welders have been using the process without an interruption of more than six months since being certified.
- D. Bolt Certification Forms for information
 - 1. Submit Bolted Field Splice Certification, Anchor Bolts Certification, and Bolted Sign Frame Connection Certification.
 - 2. Forms can be found at the end of this Section.
 - 3. Submit before substantial completion.

- E. Documentation of fabricator's AISC Bridge Component QMS (CPT) Certification for information.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Structural Steel
 - 1. Structural Pipe
 - a. Use low carbon steel according to ASTM A 53 Grade B, ASTM A 500 Grade B, or API-5L Grade B or higher, except use chemical composition requirement of silicon either 0.00 to 0.04 percent or 0.15 to 0.25 percent.
 - b. Structural tubing may be fabricated from structural steel according to the requirements of ASTM A 36 at the Contractor's option provided the additional requirement for silicon content is met.
 - c. Meet dimensional tolerances according to ASTM A 53 and ASTM A 595.
 - d. Galvanize according to AASHTO M111.
 - 1) Paint when shown.
 - 2. Hollow Structural Section (HSS)
 - a. Refer to ASTM A 500 Grade B.
 - b. Use a chemical composition requirement of silicon either 0.00 to 0.04 percent or 0.15 to 0.25 percent
 - c. Galvanize according to AASHTO M 111.
 - 3. All other Structural Steel
 - a. Refer to ASTM A 36 for all other shapes and plates.
 - b. Use a chemical composition requirement of silicon either 0.00 to 0.04 percent or 0.15 to 0.25 percent
 - c. Galvanize according to AASHTO M111.
 - 1) Paint when shown.
- B. Fasteners
 - 1. Anchor bolts, nuts, and washers
 - a. For bolts refer to ASTM F 1554 Grade 55.
 - b. For nuts refer to ASTM A 194 or A 563.
 - c. For washers refer to ASTM F 436.
 - d. Galvanize according to ASTM A 153.
 - 1) Paint when shown.
 - 2. High Strength Bolts, nuts, and washers
 - a. For bolts refer to ASTM F 3125 Grade A325.
 - b. For nuts refer to ASTM A 563 Grade DH or ASTM A 194 Grade 2H.

- c. For direct-tension indicators refer to ASTM F 959.
 - d. For other washers refer to ASTM A 436 Type 1.
 - e. Galvanize according to ASTM A 153.
 - 1) Paint when shown.
- 3. Stainless steel bolts, nuts, and washers
 - a. Refer to ASTM F 593 Type 304 for stainless steel bolts.
 - b. Refer to ASTM F 594 for stainless steel nuts.
 - c. Refer to ASTM A 193 for stainless steel washers.
- 4. U-bolts
 - a. For U-bolt refer to ASTM A 307 Grade A or ASTM A 36 round bar.
 - b. For nuts refer to ASTM A 563A Hex.
 - c. For washers refer to ASTM F 844.
 - d. Refer to ASTM A 153 for galvanized bolts, nuts, and washers.
- 5. Steel Rod
 - a. Threaded round bar refer to ASTM A 36.
 - b. For nuts refer to ASTM A 563 Grade DH or ASTM A 194 Grade 2H.
 - c. For washers refer to ASTM F 436 Type 1.
 - d. Refer to ASTM A 153 for galvanized bolts, nuts, and washers.
- 6. Stainless steel machine screws, nuts, and washers
 - a. Refer to ASTM A 493 for stainless steel machine screws 18-8 with round heads.
 - b. For stainless steel nuts refer to ASTM F 593.
 - c. Nylon flat washer
 - 1). Refer to ASTM D 4066.
 - 2). White or clear in color.
 - d. For stainless steel washers and lock washer refer to ASTM A 193.
- 7. Brass machine screws
 - a. Refer to ASTM B 134.

C. Paint

- 1. Paint only structural steel pipe, base plates, splice plates, anchor bolt hardware, and splice plate hardware when shown. Refer to Section 09972.
 - a. Structural Steel – Apply intermediate and top coats of paint over galvanization.
 - 1) Follow paint manufacturer's recommendations for surface preparation of galvanization.
 - 2) Zinc primer meeting Section 09972 can be substituted for galvanization.
 - b. Hardware - Apply intermediate and top coats of paint according to Section 09972 over galvanization.

- 1) Follow paint manufacturer's recommendations for surface preparation of galvanization.
- D. Non-shrink grout. Refer to ASTM C 1107.
- E. VMS Catwalk
1. Aluminum – General
 - a. Use 6061-T6 aluminum.
 - 1) Refer to ASTM B 308 for I-beams, H-beams, channels, angles, T-shape, and Z-shape members.
 - 2) Refer to ASTM B 429 for pipe and tube.
 - b. Grating – Use 5052 H32 aluminum expanded metal of the size shown in the contract. Refer to ASTM B 221.
 - c. Welding – Refer to AWS D1.2.
 2. Steel
 - a. Refer to this Section, Article 2.1, paragraph A if approved by the Engineer.

2.2 FABRICATION

- A. Fabricate according to UDOT Steel and Concrete Construction Manual and AWS D 1.1.
1. Refer to Section 05120 for shop inspection requirements.
- B. The fabricator must be an AISC Bridge Component QMS (CPT) Certification.
- C. Welding
1. One-time repair by welding of deficient weld is allowed without written authorization from the Engineer.
 2. Longitudinal seam welds
 - a. Use full-penetration groove welds for post and mast arm sections.
 - b. For full span type structures locate the seam weld for the mast arm in the lower quadrant of the mast arm (compression side under dead load).
 - c. For cantilever type structures locate the seam weld for the mast arm in the upper quadrant of the mast arm (compression side under dead load).
 - d. For posts locate the seam weld on the same side as the mast arm (compression side under dead load).

- D. Perform Charpy V-Notch tests for all main load carrying tension members with a ½ inch steel thickness or greater. Test results must meet requirements for Zone 2. Refer to ASTM A 370.
 - 1. This includes post, mast arm, base plate, splice plates, sign brackets, and HSS tube sections.
- E. Drill or punch bolt holes and slots to finished size.
 - 1. Do not use flame cutting on bolt holes.
 - 2. Slotted holes can be thermally cut by plasma, laser, or oxygen-acetylene methods. Grind hardened thermally cut edge to a maximum surface roughness of 1,000 micro-inch and the conical taper of the hole must be maintained within tolerance.
- F. Provide hand holes for the overhead pipe frame as shown.
- G. Locate inserts at the bottom of the mast arm. Weld 1½ inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized or brass plugs.
- H. Use ultrasonic testing on the post to base plate welds, shop splice welds, and field splice welds in post and mast arm.
 - 1. Acceptance criteria according to AWS D1.1 Table 6.3 (connections in tension).
- I. Verify fit up of the structure by assembling the structure in the shop.
- J. Paint base plates, posts, mast arms, splice plates, and associated hardware when shown.
 - 1. Paint splice plates and base plates after installation of bolt assemblies.
 - a. Primer coat of paint can be applied to all areas before installation.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify the roadway cross-section information, sign dimensions, foundation location, and clearances shown before fabrication.
- B. Field verify the post height and length of mast arm based on the as-built foundation field survey.

3.2 ERECTION

- A. Do not weld, cut or drill in the field.
- B. Meet vertical clearance requirements during construction.
- C. Temporarily support, anchor, and brace posts and mast arms during erection to produce the proper alignment and camber in the completed structure.
- D. Establish proper elevation and orientation of signs, VMS panels, posts and mast arms.
- E. Rake post as necessary during sign erection using leveling nuts to level the sign panels.
 - 1. Create a snug tight condition by wrench tightening both top and bottom anchor bolt nuts against the base plate until full contact is made at final position.
 - 2. Tighten top nuts one-sixth turn past snug tight and retighten nuts below the base plate to maintain full contact with the base plate.
 - 3. Fill out Anchor Bolt Certification form in the presence of the Inspector during bolt installation.
- F. Install high strength bolts according to Section 05120 High Strength Bolt Installation unless noted otherwise.
 - 1. Install to snug tight when shown.
 - 2. Fill out Bolted Field Splice Certification and Bolted Sign Frame Connection Certification in the presence of the Inspector while the bolts are being placed.
 - a. Provide necessary equipment and access to allow Inspector access to the connection.
- G. Fill the void between the base plate and top of foundation with non-shrink grout after completing the sign erection.
- H. Cover signs that require temporary covering with an opaque non-paper material.
 - 1. Secure cover at the rear of the sign so that the sign is not damaged and the covering remains secure during inclement weather.
 - 2. Maintain covering until removed.
- I. Do not allow traffic under a partially erected sign/VMS structure.

- J. Use two coats of a zinc-rich paint to touch up minor damage to galvanization that occurs during transportation and erection of galvanized members.
 - 1. Feather back damaged areas to form a smooth transition before applying the zinc-rich paint according to ASTM A 780.
- K. Touch up minor paint damage to painted members that occurs during transportation and erection according to Section 09972.

3.3 LIMITATIONS

- A. Do not open traffic under the following conditions:
 - 1. Information contained on a removed sign is not being provided by a new or temporary sign
 - 2. Information on the new sign conflicts with an existing sign
 - 3. New sign conflicts with the current striping
 - 4. New sign obstructs an old sign that contains required information

END OF SECTION

Bolted Field Splice Certification, Anchor Bolts Certification, and Bolted Sign Frame Connection Certification forms follow:

Bolted Field Splice Certification

Consecutively number splices looking ahead on station and increasing from left to right. Number across the lower mast arm before moving to the upper mast arm for double mast arms. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done according this Section.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact.

Send a completed copy of this form to the Engineer before substantial completion.

Project Number:

Structure Number:

Contractor Printed Name:

Inspector Printed Name:

Splice No.			
Plates are drawn into contact with each other before final tightening of any bolts.	Contractor Initials	Inspector Initials	Date
Bolts are fully tightened. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials	Date

Splice No.			
Plates are drawn into contact with each other before final tightening of any bolts.	Contractor Initials	Inspector Initials	Date
Bolts are fully tightened. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials	Date

Splice No.			
Plates are drawn into contact with each other before final tightening of any bolts.	Contractor Initials	Inspector Initials	Date
Bolts are fully tightened. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials	Date

Anchor Bolts Certification

Consecutively number anchor bolt locations looking ahead on station and increasing from left to right. Initial the appropriate box to certify that the bolt tightening has been done according to this Section.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact.

Send a completed copy of this form to the Engineer before substantial completion.

Project Number:

Structure Number:

Contractor Printed Name:

Inspector Printed Name:

Anchor Bolt Location No.			
Base plate is bearing uniformly on nuts above and below the anchor base.	Contractor Initials	Inspector Initials	Date
Bolts are tightened according to Section 02893, Article 3.2F	Contractor Initials	Inspector Initials	Date

Anchor Bolt Location No.			
Base plate is bearing uniformly on nuts above and below the anchor base.	Contractor Initials	Inspector Initials	Date
Bolts are tightened according to Section 02893, Article 3.2F	Contractor Initials	Inspector Initials	Date

Bolted Sign Frame Connection Certification

Includes the bolts that connect the HSS to the sign bracket, and the steel rod that connects the bracket to the pipe. Consecutively number sign frame bracket connections looking ahead on station and increasing from left to right. Number across the lower mast arm before moving to the upper mast arm for double mast arms. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done according to the specifications.

Send a completed copy of this form to the Engineer before substantial completion.

Project Number:

Structure Number:

Contractor Printed Name:

Inspector Printed Name:

Connection No.			
Correct number of bolts are installed according to authorized drawings.	Contractor Initials	Inspector Initials	Date
Bolts are installed to snug tight condition as defined in Section 02893.	Contractor Initials	Inspector Initials	Date

Connection No.			
Correct number of bolts are installed according to authorized drawings.	Contractor Initials	Inspector Initials	Date
Bolts are installed to snug tight condition as defined in Section 02893.	Contractor Initials	Inspector Initials	Date

Connection No.			
Correct number of bolts are installed according to authorized drawings.	Contractor Initials	Inspector Initials	Date
Bolts are installed to snug tight condition as defined in Section 02893.	Contractor Initials	Inspector Initials	Date

SECTION 02894

PRECAST ROADSIDE SIGN FOUNDATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete foundations for roadside traffic signs, non-overhead.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 291: Carbon and Alloy Steel Nuts
- C. AASHTO M 292: Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both
- D. AASHTO M 293: Hardened Steel Washers
- E. ASTM A 36: Carbon Structural Steel
- F. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- G. UDOT Quality Management Plan

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of lifting methods and devices for review.
 - a. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.

- b. Include supporting engineering calculations.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(AE) – Refer to Section 03055.

2.2 REINFORCING STEEL

- A. Refer to Section 03211.

2.3 ANCHOR BOLTS, NUTS, AND WASHERS

- A. Use bolts, nuts, and washers displaying the manufacturer's markings.
- B. Anchor Bolts – Refer to ASTM F 1554.
- C. Nuts
 - 1. Refer to AASHTO M 291 or AASHTO M 292.
 - 2. Use heat-treated Grades DH and 2H.
- D. Washers – Refer to AASHTO M 293.
- E. Galvanize according to AASHTO M 111.

2.4 ANCHOR BOLT TEMPLATES

- A. Refer to ASTM A 36.
- B. Galvanize according to AASHTO M 111.

2.5 SHAFT FABRICATION

- A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan: Precast-Prestressed Concrete Structures.
- B. Obtain a minimum compressive strength of 500 psi before stripping the forms.
- C. Permanently mark the top of the shaft with date of casting and supplier identification.
 - 1. Stamp markings in fresh concrete.

2.6 DRILLING EQUIPMENT

- A. Capable of:
 - 1. Drilling holes to the required diameter, location, alignment, and depth in the type of materials present at the shaft locations.
 - 2. Installing and removing casing.

2.7 FREE DRAINING GRANULAR BACKFILL

- A. Refer to Section 02056.

PART 3 EXECUTION

3.1 DRILLING

- A. Drilling Holes
 - 1. Drill straight, vertical holes to the depth shown or as directed by the Engineer.
 - 2. Drill holes within 3 inches of plan position.
 - 3. Remove all loose material from the bottom of the drilled holes before placing the shaft.
 - 4. Do not use water or slurry for drilling operations.
- B. Casing
 - 1. Furnish and place casing when required to prevent the drilled hole from caving and any time groundwater is encountered.
 - 2. Remove casing during or after the backfill is placed.
- C. Uncased Holes
 - 1. Drill uncased, dry, non-caving holes in a continuous operation.
- D. Obtain Engineer's approval to place shaft under water.

3.2 SHAFT INSTALLATION

- A. Place and compact free draining granular backfill in the bottom of the drilled hole to the proper elevation before placing the shaft.
- B. Place free draining granular backfill up to the top of the shaft.
 - 1. Compact by hand using a maximum of 12-inch lifts.

END OF SECTION

SECTION 02896

BOUNDARY SURVEY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide boundary survey and plat.
- B. Furnish and set right-of-way markers.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- B. Utah Code 17-23-17

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 RIGHT-OF-WAY MARKERS

- A. Pipe – Meet ASTM A 53, Schedule 40, Galvanized. Refer to GW Series Standard Drawings.
- B. Cast bronze cap – Free from defects and constructed as shown in GW Series Standard Drawings.

2.2 CONCRETE

- A. Class B concrete according to Section 03055.
- B. May substitute higher class of concrete.

PART 3 EXECUTION

3.1 RIGHT-OF-WAY MARKERS

- A. Place right-of-way markers according to GW Series Standard Drawings. Stamp onto each right-of-way marker:
 - 1. Right-of-way marker number.
 - 2. Mark exact control point location to within 0.01 ft with center punch or “dimple.”
- B. Tightly rivet cap to the pipe.

3.2 BOUNDARY SURVEY

- A. Provide record of survey plat by Utah licensed surveyor.
- B. File mylar copy of plat with county surveyor, region, and Department's Central Right-of-Way office.
- C. Accuracy – Third Order and Class I (1/10,000).

3.3 PLAT COMPLIANCE REQUIREMENTS

- A. Refer to Utah Code 17-23-17.
- B. Department Design Process.
- C. Show on the survey plat:
 - 1. Survey coordinates accurate to 5 decimal places and elevations accurate to 2 decimal places on all right-of way markers.
 - 2. Right-of-Way markers.
 - 3. Adjacent quarter corners and section corners with bearings and distances along the section line to the control line from each adjacent corner.
 - 4. Original highway control points (right-of-way markers).
 - 5. Local city or county monuments.
 - 6. Control line geometric information with reference ties to section and quarter corners.
 - 7. Tabulate right-of-way markers showing right-of-way marker number, station, offset, elevation, and project coordinates on each record of survey map.
- D. Compute and draw plat, stationing, and coordinates to the same units as the project drawings.

- E. Deliver the survey plat to Engineer on a CD in MicroStation format.
- F. Correction Factor – Show state plane to ground correction factor.
- G. Show the latitude and longitude of the control line at the beginning and end of the project.

END OF SECTION

SECTION 02911

HYDRAULIC EROSION CONTROL PRODUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydraulic Erosion Control Products (HECP) used to stabilize disturbed areas of a construction project.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM D 6459: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion
- B. ASTM D 6566: Measuring Mass per Unit Area of Turf Reinforcement Mats
- C. ASTM D 6567: Measuring the Light Penetration of a Turf Reinforcement Mat (TRM)
- D. ASTM D 7322: Determination of Rolled Erosion Control Product (RECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions
- E. ASTM D 7367: Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting

1.4 DEFINITIONS

- A. Hydraulic Erosion Control Products (HECP) – Biodegradable manufactured thermally processed natural or reinforced interlocking fibers and pre-mixed with a tackifier.
 - 1. Mixed with water and hydraulically applied as a slurry on recently constructed areas.

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and installation instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material and products in original ultra violet (UV) and weather-resistant factory labeled packages showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 HYDRAULIC EROSION CONTROL PRODUCTS (HECP)

- A. Furnish HECP according to Table 1 and the following:
1. HECP Type 1
 - a. Add a tackifier when not pre-mixed into manufacturer package, see this Section, 2.3.
 2. HECP Type 2
 3. HECP Type 3

Table 1

Requirements for Hydraulic Erosion Control Products				
Product Composition	Test Method (ASTM)	Type 1	Type 2	Type 3
Thermally Processed Fiber		85% ±10%	80% ±10%	75% ±10%
Tackifier		5% ±2%	N/A	N/A
Crosslinked Hydro-Colloidal Tackifier		N/A	10% ±2%	10% ±2%
Crimped Interlocking Fibers		N/A	N/A	5% ±2%
Moisture Content		12% ±3%	10% ±3%	10% ±3%
Organic Matter (minimum)		90%	90%	90%
Colored To Contrast Application Area		Yes	Yes	Yes
Physical Properties				
Mass per Unit Area (minimum)	D 6566	8 oz/yd ²	11 oz/yd ²	11.5 oz/yd ²
Ground Cover (minimum)	D 6567	90%	95%	97%
Water Holding Capacity (minimum)	D 7367	600%	1000%	1400%
Performance Properties				
Functional Longevity		3-6 months	6-12 months	12-18 months
Cover Factor (maximum)	D 6459	0.10	0.05	0.01
Vegetation Establishment (minimum)	D 7322	300%	400%	500%

2.2 WATER

- A. Free of dirt, silt and other detrimental matter.

2.3 TACKIFIER

- A. General
 - 1. Free from growth or germination inhibiting factors.
 - 2. Nonflammable
 - 3. Nontoxic to aquatic organisms.
 - 4. Functional for a minimum of 180 days.
- B. Guar-based tackifier
 - 1. Derived from ground endosperm of guar seeds (*Cyamopsis tetragonolobus*) and treated with dispersant agents.
 - 2. Apply at a rate of 50 lbs per acre.
- C. Psyllium-based tackifier
 - 1. Manufactured from the finely ground muciloid coating of *Plantago ovata* or *Plantago ispaghula* seeds.
 - 2. Will hydrate when mixed with water to form a slurry and produces a firm, resilient and rewettable membrane on the soil surface after application.
 - 3. Apply at a rate of 100 lb per acre.
- D. Starch-based tackifier
 - 1. Typically derived from corn or potatoes in a non-ionic, cold-water soluble (pre-gelatinized) granular form.
 - 2. Apply at a rate of 150 lb/acre.

PART 3 EXECUTION

3.1 PREPARATION

- A. Complete required grading, topsoil placement, and seeding in designated areas before applying HECP.
- B. Apply HECP within 24 hours after seeding.
- C. Provide sufficient time for HECP to cure according to manufacturer's recommendation before precipitations falls.

3.2 HECP APPLICATION

- A. Use HECP components pre-packed by the manufacturer.
 - 1. Do not field mix materials unless using a HECP Type 1 product that does not include a pre-mixed tackifier into manufacturer package.
- B. Mix water and HECP according to the manufacturer's recommendation.
- C. Apply HECP at the rates in Table 2, unless otherwise specified.

Table 2

HECP Application Rates	
HECP Type	Minimum Rates (lbs per acre)
Type 1	2,000
Type 2	3,500
Type 3	3,500

- D. Apply a uniform layer of HECP slurry to targeted areas from both the top and bottom of the slope to meet manufacturer's recommendation for installed thickness and ground coverage.
 - 1. Remove overspray before the HECP slurry dries.

END OF SECTION

SECTION 02912

TOPSOIL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and spreading topsoil on prepared areas.
- B. Stripping topsoil from on-site locations and placing in stockpile.
- C. Spreading stockpiled topsoil on prepared areas.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. AASHTO T 194: Determination of Organic Matter in Soils by Wet Combustion
- B. Textural Triangle National Soils Handbook

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Submit for information, Contractor-furnished topsoil laboratory test results from each topsoil source to be used a minimum of seven working days before soil delivery.
- B. Submit for information, soils samples according to this Section, Article 2.2, paragraph A.

PART 2 PRODUCTS

2.1 CONTRACTOR FURNISHED TOPSOIL

- A. Determine PH, EC, and SAR with a saturated soil paste or 1:1 soil/water testing method. Meet the following:
 - 1. PH 6.0 to 8.0
 - 2. Electrical Conductivity (EC) Less than 4 ds/m
 - 3. Sodium Adsorption Ratio (SAR) Less than 10

- B. Organic Matter
 - 1. 1 to 20 percent.
 - 2. Determined by the release upon combustion Walkley-Black or modified Walkley-Black testing method. Refer to AASHTO T 194.
- C. Textural Classification
 - 1. Loam, sandy loam, silt loam, or sandy clay loam not exceeding the percentiles in Table 1. Refer to Textural Triangle National Soils Handbook, Part 603-5.

Table 1

Textural Classification	
Soil Component	Percentile Range
Sand	20 to 70
Silt	20 to 70
Clay	10 to 30

- 2. Determine particle size analysis by the hydrometer testing method.
- D. Topsoil free of:
 - 1. Subsoils (no B or C horizon soils)
 - 2. Coarse sand and gravel
 - 3. Stiff clay, hard clods, or hard pan soils
 - 4. Rock larger than 3 inches in any dimension
 - 5. Trash, litter, or refuse
 - 6. Noxious weeds and weed seeds
- E. Topsoil may contain a maximum of five percent rock smaller than 3 inches.

2.2 SOURCE QUALITY CONTROL – CONTRACTOR FURNISHED MATERIAL

- A. Obtaining Soil Samples
 - 1. Obtain soil samples while the Engineer is present. Provide no less than ½ lb per soil sample.
 - 2. Obtain samples from a thin slice of soil cut from the side of a freshly dug hole or by using a soil auger or sampling tube.
 - 3. Mix the several small samples taken from various places around the source together to produce a composite sample.
 - 4. More than one composite sample may be required if the topsoil horizon changes significantly across the source.
 - 5. Store samples in a clean container at room temperature and out of direct sunlight.
 - 6. Label the location and date on each sample container.
 - 7. Provide additional soil samples for verification if requested by the Engineer.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Complete final grading, trench settling, and surface preparation before placing topsoil.
- B. Place and spread topsoil as the slope is being constructed on steep cut slopes steeper than 2:1 and higher than 15 ft that require the placement of topsoil. Finish according to this Section, Article 3.3, paragraph D.
- C. Provide a suitable topsoil surface just before seeding on the remaining topsoiled areas not covered under this article, paragraph B. Suitable topsoil surface is:
 - 1. Non-compacted and finished according to this Section, Article 3.3.
 - 2. Weed free.
 - 3. Finish grade uniform surface with smooth transitions between grade changes and disturbed areas.
- D. Do not strip or handle wet topsoil.
- E. Establish finish grade at 1 inch below the top of all walks, curbs, mow strips, and other hard surfaces for areas receiving seed or turf seed and 1½ inch for areas receiving turf sod.

3.2 STRIP AND STOCKPILE TOPSOIL

- A. Strip the topsoil:
 - 1. Only from areas shown or determined by Engineer.
 - 2. To a depth determined by the Engineer.
- B. Remove and dispose of any roots larger than 2 inches in diameter or 12 inches in length.
- C. Stockpile stripped topsoil:
 - 1. At locations acceptable to the Engineer.
 - 2. So that placement or activity around the stockpile does not damage or impact any existing trees, shrubs, or environmentally sensitive areas. Obtain appropriate clearances if such impacts are unavoidable.
- D. Grade to minimize erosion on and around the stockpiles.

3.3 SPREAD STOCKPILED AND CONTRACTOR-FURNISHED TOPSOIL

- A. Clear area to receive topsoil of all trash, debris, weeds, and rock 3 inches or larger and dispose of objectionable material in an approved manner.
- B. Place and spread the stockpiled topsoil over the prepared slopes to the plan depths. Use 4 inches if no depth is indicated in the plans.
- C. Disc or harrow the placed topsoil along the contour on slopes 3:1 and flatter or cat-track the slopes to create continuous cleat tracks that run parallel with the contours.
- D. Cat-track slopes steeper than 3:1 to create continuous cleat tracks that run parallel with the contours.

END OF SECTION

SECTION 02922

SEED, TURF SEED, AND TURF SOD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Seed, turf seed, and turf sod requirements and application.
- B. Surface preparation.

1.2 RELATED SECTIONS

- A. Section 02912: Topsoil

1.3 REFERENCES

- A. Utah Seed Law

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit for information, copy of the purchase order documenting that all seeds, including substitutions, have been acquired before the seeding window begins.
 - 1. Refer to this Section, article 1.6 for seeding information.
 - 2. List the common and botanical name for each seed species on the purchase order.
- B. Submit for information, certification that turf sod is nursery grown and contains a minimum of three varieties of Kentucky Blue Grass.
- C. Submit for information, certification indicating the date and time sod was cut at the nursery.
- D. Submit for information, fertilizer labels.
- F. Submit for information legible copy of Seed Certification – Include the following on seed certification reports and labels:
 - 1. Botanical name (include variety if applicable)
 - 2. Common name
 - 3. Name of seed testing laboratory
 - 4. Lot number and address of the seed company

5. Weed seed (percent)
6. Other crop seed (percent)
7. Inert matter (percent)
8. Pure live seed (percent)
9. Noxious weed seed (name and rate of occurrence)
10. Date tested (month and year)
11. Germination (percent)
12. Hard seed (percent)
13. Net weight (do not include container weight)
14. Pure live seed weight
15. Collection locations for native shrub and tree species (state, county, elevation)

- G. Submit for information manufacturer's directions on drill calibration two working days before seeding. Refer to this Section, Article 3.3.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Mixing Seed
1. Notify Engineer seven calendar days before mixing seed.
 2. Engineer will verify that the seed certification report or label represents the seed lot from which the seed is furnished.
 3. Mix the different seed varieties to provide an even blend.
 4. Bag the mixed seed, seal the container, and attach a signed Department label to the exterior.
- B. Deliver seed or turf seed to job site in original containers showing analysis of seed mixture, net weight, and date and location of packaging. Damaged packages are not acceptable.
- C. Strip turf sod from nursery no more than 24 hours before laying.
- D. Deliver fertilizer in containers showing weight, chemical analysis, and name of manufacturer. Store fertilizer in a weatherproof location.

1.7 SCHEDULE

- A. Pre-measure the area to be seeded before ordering seed from supplier. The Engineer must approve the measuring technique and determined quantity.
- B. Seeding Window
1. Complete all general roadside seeding within the appropriate seeding window.
 2. Postpone seeding until the following year if the seeding is not completed within the given window.

3. A late winter exception to the seeding window may be obtained from the Engineer if suitable weather and soil conditions exist.

<u>Elevation</u>	<u>Seeding Window</u>
Below 4,000 ft	October 1 – December 31
4,000 to 6,000 ft	September 15 – December 1
Above 6,000 ft	September 1 – November 15

- C. Turf seed and turf sod can be placed only after irrigation system is installed and operational.
- D. Topsoil
 1. Refer to Section 02912.
 2. Place topsoil just before seeding to eliminate competition from weeds.
 3. Coordinate topsoil placement with the above seeding window.

PART 2 PRODUCTS

2.1 SEED AND TURF SEED

- A. Meet the Utah Seed Law – Utah Code - Title 4, Chapter 16.
- B. Supply seed on a pure live seed (PLS) basis.
- C. Obtain seed from lots that have been tested by a state certified seed testing laboratory such as Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST).
 1. Seed germination test older than 18 months for grass seed and 9 months for shrub or tree seed are not acceptable.
 2. Based on the amount or type of seed required on a project, the Department may require additional testing by the Department of Agriculture.
- D. Do not use wet, moldy, or otherwise damaged seed.
- E. Seed Substitutions
 1. Contact the major seed brokers in the state to verify that the seed is unavailable before requesting a seed substitution.
 2. Obtain approval for a seed substitution.

2.2 TURF SOD

- A. Healthy and well-rooted nursery grown Kentucky Blue Grass sod comprised of a minimum of three varieties and free of weeds.

- B. Machine cut in straight, uniform strips or rolls, cut at a depth between $\frac{3}{4}$ inch and 1 inch.

2.3 FERTILIZER (turf sod and turf seed areas only)

- A. Uniform in composition, dry, and free flowing.
 - 1. Turf seed or turf sod – Elemental nitrogen in granular form. Phosphorus and potassium are optional and may be applied with nitrogen in granules. Use a slow release form of a minimum 50 percent nitrogen such as sulfur coated urea or urea formaldehyde.
 - 2. Apply elemental nitrogen with a concentration ranging from 21-34 percent if hydroseeding method is used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Complete all final grading, irrigation work, trench settling, topsoil placement, and surface preparation before seed or sod application.
- B. Prepare general seedbed for all seeded and sodded areas.
 - 1. Verify that a suitable topsoil surface has been prepared according to Section 02912 before seeding.
 - 2. Do not work topsoil or seed when the soil is saturated or frozen.
- C. Prepare Turf Seedbed
 - 1. Review finish grade to confirm that topsoil is 1 inch below the top of all walks, curbs, mow strips, and other hard surfaces.
 - 2. Apply fertilizer at the rate of 2 lb/100 yd² and mix thoroughly into upper 2 inches of topsoil.
 - 3. Do not apply fertilizer and seed at the same time in the same machine.
- D. Prepare Turf Sod Surface
 - 1. Review finish grade to confirm that topsoil is 1½ inch below the top of all walks, curbs, mow strips, and other hard surfaces.
 - 2. Apply fertilizer at the rate of 2 lb/100 yd² and mix thoroughly into upper 2 inches of topsoil.
 - 3. Level and roll prepared areas using a 21 gal water-filled hand roller containing 8 to 10 gal of water.
 - 4. Lightly rake and dampen with water the top $\frac{1}{8}$ to $\frac{5}{8}$ inches of soil just before laying the sod.

3.2 SEEDING – GENERAL

- A. Notify the Engineer seven working days before seeding.
- B. Apply seed at the rate indicated in the Seed Schedule as shown. Note that drill seed and broadcast seed are applied at different rates.

3.3 DRILL SEEDING METHOD

- A. Use the drill method of seeding on accessible slopes 3:1 and flatter.
- B. Use a drill equipped with the following:
 - 1. Depth band
 - 2. Seed box agitator
 - 3. Seed metering device
 - 4. Furrow opener
 - 5. Packer wheels or drag chains
- C. Use the drill manufacturer's directions in the presence of the Engineer. Calibrate the drill to apply seed at the rate indicated in the seeding schedule.
- D. Space drill rows a minimum of 6 inches and a maximum of 8 inches.
- E. Fill the seed boxes no more than half full when drilling on a slope.
- F. Set depth bands to drill seeds to a ½ inch depth.
- G. Drill along the contour.
- H. Maintain the drill at the calibrated setting throughout the seeding operation.
- I. Allow the furrows that are created by the drill to remain.

3.4 BROADCAST SEEDING METHOD

- A. Use the broadcast method of seeding under the following conditions:
 - 1. Slopes steeper than 3:1.
 - 2. Slopes 3:1 and flatter where the area to be seeded is inaccessible to drill.
 - 3. The area to be seeded is not large enough to justify using a drill.
 - 4. Rocky surface conditions will damage a drill.

- B. Obtain approval of the broadcast method by demonstrating the procedure on a 100 yd² area.
- C. Evenly broadcast seed using either:
 - 1. A cyclone seeder or other approved mechanical seeder.
 - 2. A hydroseeder.
 - a) Apply seed, water, and 300 lb of cellulose fiber mulch (tracer) per acre.
- D. Do not seed during windy weather or when soil is saturated.
- E. Incorporate the seed into the soil by one of three methods:
 - 1. Cat-tracking by running the dozer up and down the slope creating continuous cleat tracks that run parallel with the contours.
 - 2. Hand raking the seed in ½ inch deep and along the contours of the slope.
 - 3. Slope chaining by pulling the chain along the contour until the seed is covered.
- F. Obtain approval from the Engineer that the seed has been adequately incorporated into the soil before applying wood fiber mulch, erosion control blanket, flexible growth medium, flexible channel liner, or other topdressing.

3.5 TURF SEEDING

- A. Apply turf seed after seedbed preparation. Refer to this Section, Article 3.4, paragraph C.
- B. Roll seeded areas using a hand roller half filled with water.
- C. Lightly water and program the irrigation system to maintain a moist seedbed.
- D. Rope off newly seeded areas along walkways using bright plastic ribbon tape attached to stakes.

3.6 TURF SOD PLACEMENT

- A. Prepare sod bed and place sod with all edges and joints tightly butted.
 - 1. Do not stretch or overlap sod.
 - 2. Keep length seams in a straight line.
- B. Lay turf sod with staggered joints and trim off excess material along the edges.

- C. Roll sod immediately after placing using a hand roller half filled with water.
 - 1. Re-roll if depressions still remain.
 - 2. Thoroughly water with a fine spray to a depth sufficient that the underside of the new sod and soil immediately below the sod are thoroughly wet.

END OF SECTION

SECTION 02931

POLE PLANTINGS/WILLOW CUTTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Collecting and installing pole plantings or willow cuttings.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. International Society of Arboriculture: Current Standards for Pruning

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 SCHEDULE

- A. Install poles and cuttings in the fall after October 15, and before the ground becomes frozen or in the spring after the ground thaws and before April 15.

PART 2 PRODUCTS

2.1 POLES AND CUTTINGS

- A. Collect poles and cuttings from live native stands of the species listed from October 15, to February 15.
- B. Obtain poles and cuttings from live trees and shrubs that will be destroyed due to highway construction, from areas adjacent to the project, or from locations that are ecologically matched in climate and elevation.
- C. Obtain necessary permits from appropriate regulatory agency or permission from landowner before collecting poles and cuttings outside the right-of-way.
- D. Prune branches using current standards from the International Society of Arboriculture when collecting poles and cuttings from trees or shrubs that will remain.

- E. Remove no more than $\frac{1}{3}$ of the branches from any tree or shrub when obtaining poles and cuttings from vegetation that will remain within the right-of-way.
- F. Supply poles and cuttings that meet the following size constraints:
 - 1. Pole – Cut branches at a 45 degree angle, 6 ft long and 1 to 3 inches in diameter from one to three-year-old growth.
 - 2. Willow Cutting – Cut stems at a 45 degree angle, 3 ft long, and $\frac{1}{3}$ to $\frac{3}{4}$ inch in diameter from one to two-year-old growth.

PART 3 EXECUTION

3.1 STORE

- A. Store dormant poles and cuttings acquired but not planted in the fall, until the ground thaws.
- B. Store in plastic bags at temperatures between 32 degrees F to 41 degrees F or outside in snow-filled plastic bags.
- C. Do not allow the poles or cuttings to dry out or break bud while being stored.

3.2 INSTALL

- A. Stake poles and cuttings at plan locations for approval or as directed.
- B. Create a hole deep enough to accommodate 90 percent of the length of the pole or cutting using an auger or water stinger.
- C. Remove 1 inch from the basal end of the pole or cutting just before planting.
- D. Place one pole or one cutting in the hole basal end first.
- E. Backfill and compact around the pole or cutting to eliminate air pockets.
- F. Water the pole or cutting and add more backfill if settling occurs.

END OF SECTION

SECTION 02932

TREES, SHRUBS, AND GROUNDCOVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and installing plant material.

1.2 RELATED SECTIONS

- A. Section 02912: Topsoil

1.3 REFERENCES

- A. ANSI Z 60.1: American Standard for Nursery Stock

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit for information, a copy of the plant purchase order indicating plant names, sizes, quantities, and unit prices. Submit within 90 calendar days from the Notice to Proceed.
- B. Submit for information, plant substitutions
 1. Obtain a signed statement from three wholesale nurseries, noted for stocking the specified plants, indicating that the plants are unavailable.
 2. The signed statements and a written request indicating the size and species of the unavailable plants and their suggested replacements.
 3. Substitutions will not be approved after 120 calendar days from the Notice to Proceed.
- C. Submit for information, all necessary inspection certificates for each shipment of plants as required by Utah Laws and Regulations.

1.6 QUALITY ASSURANCE

- A. Verify all plants meet ANSI specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Secure required plants at a nursery within 60 calendar days from the Notice to Proceed.
- B. Grow plants under full exposure to climatic conditions similar to those found on the project for a minimum of 60 calendar days.
- C. Notify the Engineer at least 14 calendar days before delivering the plants to the site.
- D. Deliver plant materials to the work site in covered vehicles just before placement.
- E. Maintain delivered plants in a healthy condition.
 - 1. Protect balled and burlapped rootballs from sun and wind by covering with soil or other suitable material if not planted immediately upon delivery.

1.8 SCHEDULE

- A. Install irrigated plants using the following schedule:

<u>Elevation</u>	<u>Planting Season</u>
Below 4,000 ft*	March 1 - December 1
4,000 to 6,000 ft	April 15 - October 15
Above 6,000 ft	May 1 - July 1
* No planting in July or August.	

- B. Install non-irrigated plants in the fall after the plant is dormant and before the ground freezes.

PART 2 PRODUCTS

2.1 PLANTS

- A. Supply healthy plants of the species and size specified, true to form, free from disfiguring knots, sunscald, frost cracks, bark abrasions, and all forms of infestation and disease.
- B. Provide legible labels attached to all plants, flats, bundles, or other containers indicating botanical genus, species, and size.

- C. Supply trees with straight central leaders capable of standing upright without the support of stakes or guys.
- D. Supply containerized plants with root systems fully established in the container.
- E. Do not use balled and burlapped plants if the ball of earth surrounding roots has been cracked or broken or if the burlap is not secure.
- F. Use bare-root plant material only with approval.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that the area prepared to receive plants is graded properly according to the plan, all work is completed in the area, and that topsoil has been placed. Refer to Section 02912.
- B. Install the irrigation system and have it fully operational before installing plants.
- C. Stake or delineate plant locations for approval before installation.

3.2 INSTALLATION

- A. General
 - 1. Install plants using the plan details.
 - 2. Water the plants within one hour of installation to saturate the rootball to a minimum of 4 inches below and around the plant hole.
 - a. Add more backfill if settling occurs.
- B. Containerized Plants
 - 1. Excavate plant holes to twice the diameter and the same depth of the rootball.
 - 2. Carefully remove the plant from its container, scarify the sides and bottom of the rootball if needed, and place it in the prepared hole.
 - 3. Place excavated soil in 4 inch lifts around the rootball and eliminate voids by tamping the soil between each lift.
- C. Balled and Burlapped Plants
 - 1. Excavate plant holes to twice the diameter and the same depth of the rootball.
 - 2. Gently place the plant in the prepared hole with burlap securely intact.

3. Do not mishandle or break root balls.
 4. Carefully remove any wire baskets and the top half of the burlap without disturbing the root ball.
- D. Tubeling Plants
1. Auger a hole the same size as the tube.
 2. Gently place watered tubeling in the prepared plant pit immediately following excavation of the hole so that the roots are not tangled, compacted, or curled up at the ends.
 3. Compress the soil at the base of the tubeling to eliminate voids between the rootball and existing soil.

3.3 CLEAN AND MAINTAIN

- A. Remove foreign materials from site such as containers, burlap, and twine collected during installation.
- B. Remove any tags, labels, or other items attached to the plant material after final plant inspection.
- C. Water and maintain the plants in a healthy condition until the final plant inspection.

END OF SECTION

SECTION 02938
TREE PRUNING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal and disposal of tree limbs.

1.2 RELATED SECTIONS

- A. Section 02231: Site Clearing and Grubbing.

1.3 REFERENCES

- A. ANSI Z 133.1: Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush – Safety Requirements.
- B. Current Standards for Pruning – International Society of Arboriculture (ISA)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Submit for information, a copy of all necessary permits from the municipality, city forester, or both in which the work is seven calendar days before work begins.
- B. Submit for information, a copy of the arborist's certificate from ISA.

1.6 QUALITY ASSURANCE

- A. Contractor must provide an ISA certified arborist to supervise tree pruning.

PART 2 PRODUCTS

2.1 DISINFECTANT

- A. Chlorine based

PART 3 EXECUTION

3.1 TREE PRUNING

- A. Conform to ANSI Z 133.1 and Current Standards for Pruning – International Society of Arboriculture (ISA).
- B. Remove tree branches extending over the roadway to provide a clear height of 15 ft above the paved surface and 10 ft above sidewalks.
- C. Spray pruning equipment with disinfectant after coming in contact with diseased plant material.
- D. Use the “Natural Target” or “Drop Crotch” pruning method when removing limbs.
- E. Do not top, pollard, stub, or dehorn any tree.
- F. Make all pruning cuts sufficiently close to the trunk or parent limbs without cutting into or removing the branch collar or the branch bark ridge.
- G. Prune trees to make them shapely, symmetrical, and typical of the natural form of the species being pruned.
- H. Do not remove branches that will deform the appearance of the tree.

3.2 BRANCH DISPOSAL

- A. Shred removed branches into wood chips 6 inches or smaller.
- B. Remove all wood chips larger than 6 inches.
- C. Broadcast shredded branches as determined by the Engineer over and around the site where trees are being pruned or removed and where placement will not be detrimental to vegetation growth. Refer to Section 02231.

END OF SECTION

SECTION 02961
ROTOMILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rotomilling of the existing bituminous surface at the location and to the depth shown.

1.2 RELATED SECTIONS

- A. Section 02741: Hot Mix Asphalt (HMA)

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use the milled material obtained from the rotomill process passing a 2 inch sieve as optional use of Reclaimed Asphalt Pavement (RAP). Refer to Section 02741.

2.2 EQUIPMENT

- A. Use power-operated track propelled planing machine or grinder:
 - 1. Capable of milling to plan cross slope.
 - 2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
 - 3. Maximum of $\frac{5}{8}$ inch between the cutting teeth on the mandrel.
- B. Use appropriate cleaning equipment capable of sweeping, picking up millings, and cleaning the vertical edge to clean up after milling operation.

PART 3 EXECUTION

3.1 PROCEDURE

- A. The Engineer:
 - 1. Measures and records rotomilling depths, taking two random measurements every 1,000 ft of each pass of the milling machine.
 - 2. May require an adjustment to the depth of the milling operation, within tolerances, to remove unacceptable material or to improve ride.
- B. Rotomill existing bituminous pavement surface to the width and depth shown not to exceed an additional $\frac{3}{8}$ inch of plan depth, measured from original surface to the top of the ridge.
- C. Load the reclaimed material from milling operation into a truck in one operation. Milled material is the property of the Contractor unless specified otherwise.

3.2 CLEAN AND REPAIR

- A. Remove and clean all millings from the surface daily. Control dust created by the cutting action. Clean rotomilled surface after milling operation and before opening to traffic.
- B. Verify all milled surfaces are sturdy and sound.
 - 1. Remove any material that is loose or not well bonded.
- C. Dispose of the milled material

END OF SECTION

SECTION 02963

PROFILE ROTOMILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rotomilling of the existing bituminous surface at the location and to the profile and cross-slope shown.

1.2 RELATED SECTIONS

- A. Section 02741: Hot Mix Asphalt (HMA)

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit for information the record of profile grades.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use the milled material obtained from the rotomill process passing a 2 inch sieve as optional use of Reclaimed Asphalt Pavement (RAP). Refer to Section 02741.

2.2 EQUIPMENT

- A. Use power-operated track propelled planing machine or grinder:
 - 1. Capable of milling to the plan cross slope.
 - 2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
 - 3. Maximum of $\frac{5}{8}$ inch between the cutting teeth on the mandrel.
- B. Use appropriate cleaning equipment capable of sweeping, picking up millings, and cleaning the vertical edge to clean up after milling operation.

PART 3 EXECUTION

3.1 PREPARATION

- A. Measure and record profile grades during rotomilling operation:
 - 1. Use a means that provides the required accuracy.
- B. Achieve a rotomilled depth in the field of plan depth not to exceed an additional $\frac{1}{4}$ inch, measured from original surface to the top of the ridge.
- C. Rotomill existing bituminous pavement surface to a depth below final profile and cross slope grade as shown.
- D. Clean rotomilled surface after milling operation and before opening to traffic.
- E. Remove and replace or repair damage by the Contractor's operation outside the widths and depths as shown.
 - 1. Repair damage to traffic due to loose material on milled surface.
- F. Use a wire guide or other approved grade control methods to control the profile grade and cross slope of the rotomill.
- G. Load the reclaimed material from milling operation into a truck in one operation.
 - 1. Remove and clean all millings from the surface daily.
 - 2. Control dust created by the cutting action.
- H. Milled material is the property of the Contractor unless specified otherwise.
- I. Dispose of the milled material

3.2 CLEAN AND REPAIR

- A. Remove and clean all millings from the surface daily.
 - 1. Control dust created by the cutting action.
 - 2. Clean rotomilled surface after milling operation and before opening to traffic.
- B. Verify all milled surfaces are sturdy and sound.
 - 1. Remove any material that is loose or not well bonded.
- C. Dispose of the milled material.

END OF SECTION

SECTION 02981

GRINDING PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedure for grinding existing concrete pavements.

1.2 RELATED SECTIONS

- A. Section 02701: Pavement Smoothness

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Profilograph information as required for smoothness testing. Refer to Section 02701.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Provide and operate equipment utilizing diamond blades mounted on a self-propelled machine designed for grinding and texturing pavement.
- B. Do not use equipment that causes damage to the transverse or longitudinal joints.
- C. Use vacuuming equipment to remove residue and excess water.

PART 3 EXECUTION

3.1 GRIND

- A. Grind until the surface of both sides of the transverse joints and cracks are in the same plane and meet the required smoothness.
- B. Provide a uniform finished texture.

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- C. Perform grinding in a longitudinal direction. Begin and end grinding at lines normal to the pavement centerline.
- D. Do not cause damage to the underlying surface of the pavement.
- E. Provide resultant surface in a parallel, corrugated type texture consisting of grooves between 0.090 and 0.150 inches wide. Create a distance between the grooves of between 0.060 and 0.13 inches. Make peaks of the ridges approximately $\frac{1}{16}$ inch higher than the bottom of the grooves. Maintain cross slope drainage.
- F. Provide uniform transverse slope of the pavement with no depressions or misalignment of slope greater than $\frac{1}{4}$ inch in 10 ft when tested with a 10 ft straightedge.
- G. Do not grind structures.
- H. All residue from the grinding process becomes property and responsibility of the Contractor.

3.2 SMOOTHNESS TESTS

- A. Refer to Section 02701.

END OF SECTION

SECTION 02982

BRIDGE CONCRETE GRINDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grinding of concrete bridge decks, approach slabs, and sleeper slabs for precast concrete deck panel systems.
- B. Grinding of existing concrete bridge decks, approach slabs, and sleeper slabs for rehabilitation work.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Provide and operate equipment utilizing diamond blades mounted on a self-propelled machine designed for grinding and texturing pavement.
- B. Do not use equipment that causes damage to the transverse or longitudinal joints.
- C. Use vacuuming equipment to remove residue and excess water.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Provide a uniform finished texture.
- B. Limit transverse and longitudinal deviations to less than 1/8 inch from the lower edge of a 10-foot straightedge after grinding for all locations.

- C. Perform grinding in a longitudinal direction.
 - 1. Begin and end grinding at lines normal to the bridge centerline.
- D. Protect expansion joints during grinding operations.
- E. Create a surface in a parallel, corduroy-type texture consisting of grooves between $\frac{1}{16}$ and $\frac{1}{4}$ inches wide. Use a distance between the grooves of between $\frac{1}{16}$ and $\frac{1}{4}$ inches.
 - 1. Limit height of ridges to $\frac{1}{16}$ inch.
- F. Maintain cross slope drainage.
- G. Tailings from the grinding process become the property and responsibility of the Contractor.

3.2 GRINDING PRECAST DECKS AND APPROACH SLABS

- A. Grind surfaces of concrete bridge decks and approach slabs until both sides of joints are in the same plane and the entire surface, including the sleeper slab to roadway interface, meets the requirement of this Section, 3.1B.
 - 1. Cure shear stud blockout locations for 24 hours before grinding.
 - 2. Limit grinding to a depth of no more than $\frac{1}{4}$ inch.

3.3 GRINDING EXISTING DECK SURFACES

- A. Grind surfaces as shown.
- B. Verify concrete cover to reinforcing steel by ferrosensing or an equivalent method before grinding.
 - 1. Notify the Engineer if concrete cover is less than 2 inch or that shown.
 - 2. Do not damage existing rebar.

END OF SECTION

SECTION 03055

PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Portland Cement Concrete.

1.2 RELATED SECTIONS

- A. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 6: Fine Aggregate for Hydraulic Cement Concrete
- B. AASHTO M 80: Coarse Aggregate for Hydraulic Cement Concrete
- C. AASHTO M 85: Portland Cement
- D. AASHTO M 154: Air-Entraining Admixtures for Concrete
- E. AASHTO M 157: Ready-Mixed Concrete
- F. AASHTO M 194: Chemical Admixtures for Concrete
- G. AASHTO M 295: Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- H. AASHTO M 307: Silica Fume Used in Cementitious Mixtures
- I. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
- J. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests
- K. AASHTO T 358: Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration
- L. ASTM C 150: Portland Cement
- M. ASTM C 595: Blended Hydraulic Cements

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- N. ASTM C 1157: Hydraulic Cement
- O. ASTM C 1567: Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- P. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete
- Q. American Concrete Institute (ACI) Manual of Concrete Practice
- R. UDOT Materials Manual of Instruction
- S. UDOT Minimum Sampling and Testing Requirements
- T. UDOT Quality Management Plan

1.4 DEFINITIONS

- A. Cold Weather Protection Period: The required time during which the concrete is maintained at or above a specific temperature to prevent freezing of the concrete and to ensure the necessary strength development for structural safety.

1.5 SUBMITTALS

- A. Mix design for all A and AA concrete classes to be used for approval.
 - 1. The Department approves concrete mix designs based on trial batch test results or on Department project history.
 - 2. Include at least the following:
 - a. The proposed mix design.
 - b. Target slump value.
 - c. Trial batch test results.
 - d. Test results verifying that coarse and fine aggregates meet this Section, Article 2.2, paragraph B.
 - e. Test results for the proposed mix design for potential reactivity of coarse and fine aggregates according to UDOT Quality Management Plan 506: Ready-Mix Concrete.
 - f. Test results demonstrating the ability of the combinations of cementitious materials and aggregates to control the reactivity when using potentially reactive aggregates in a mix design.
 - g. Written plan for admixtures. Refer to this Section, Article 2.2, paragraph D.

- h. Well-graded combined aggregate gradation for the mix design when used.
 - 1) Provide targets for each required sieve (listed in Tables 5 and 6) for control and acceptance.
 - 2) Submit the coarseness factor, 0.45 power chart, percentage retained (8-18 gradation chart) or a combination of methodologies.
 - 3) Identify the aggregate size and number of component stockpiles.
 - 4) Provide gradations for each component stockpile and the target percentages of each stockpile used to achieve the total combined gradation.
- B. Mix design, manufacturer's product data, or manufacturer's labeling for Class B concrete for approval.
- C. Cold Weather Concreting Plan and Hot Weather Concreting Plan for review.
 - 1. Include the following:
 - a. Detailed procedures for the placement, protection, curing, and temperature monitoring of concrete during cold and hot weather.
 - b. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
 - c. Refer to this Section, Article 3.1, paragraph D for cold weather concreting requirements and Article 3.1, paragraph E for hot weather concreting requirements.
 - 2. Allow the Engineer 10 calendar days to review the plans.
 - a. The Engineer may grant an increase in contract time when this review and approval time is exceeded.
 - b. This review period applies each time the plans are submitted.
 - 3. Do not begin cold weather concreting before the Cold Weather Concreting Plan is approved.
 - 4. Do not begin hot weather concreting before the Hot Weather Concreting Plan is approved.
 - 5. Not required for precast concrete members provided by prequalified suppliers. Refer to this Section, Article 3.1, subparagraph D1 for cold weather. Refer to this Section, Article 3.1 paragraph E3 for hot weather.

1.6 ACCEPTANCE

- A. Acceptance for strength, air entrainment, and slump is according to UDOT Minimum Sampling and Testing Requirements.

- B. The Department may accept the item at a reduced price when concrete is below specified strength and does not have a separate strength pay factor.
1. The pay factor will be applied to the quantity of the pay item that is represented by the strength tests that fall below a specified strength.
 2. Department will calculate the pay factor using Table 1 based on 28 day compressive strength.

Table 1

Price Reduction for 28 Day Compressive Strength		
AA(LS), AA(PS), AA(ES) AA(P) Concrete Classes		AA(AE), A(AE), Concrete Classes
PSI below Specified Strength	Pay Factor	Pay Factor
1-100	0.95	1.0
101-200	0.90	0.95
201-300	0.85	0.85
301-400	0.80	0.80
More than 400	Reject	Reject

3. The Engineer may accept a “reject” lot based on an engineering analysis. The Department applies a 0.50 pay factor if a reject lot is allowed to remain in-place.

PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

- A. Use only concrete mixes that have a Department approved mix design.
1. Refer to the requirements in Table 2.

Table 2

Concrete Classes and Mix Requirements							
Class	Coarse Aggregate Size	Maximum Water / Cementitious Ratio	Maximum Percent Shrinkage at 28 days AASHTO T 160	Chloride Ion Penetration AASHTO T 358 Table 1	Air Content Percent (%) *	Mix Design Compressive Strength f'_{cr} (psi)	28 Day Minimum Compressive Strength f'_c (psi) **
AA(LS)	1" to No. 4 ¾" to No. 4	0.40	0.03	Low to Negligible	5.0 - 7.5	5,200	4,000
AA(PS)	¾" to No. 4	0.40	N/A	N/A	5.0 - 7.5	6,200 or $f'_c + 1200$	5,000 or as shown
AA(P)	2" to No. 4 1½" to No. 4 1" to No. 4	0.44	0.042	N/A	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5	5,200	4,000
AA(ES)***	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.44	0.03	N/A	4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5,200	4,000
AA(AE)	2" to No. 4 1½" to No. 4 1" to No. 4 ¾" to No. 4	0.44	N/A	N/A	4.0 - 7.0 4.5 - 7.5 5.0 - 7.5 5.0 - 7.5	5,200	4,000
A	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.53 0.53 0.48	N/A	N/A	N/A	3,900	3,000
A(AE)	1½" to No. 4 1" to No. 4 ¾" to No. 4	0.53 0.53 0.48	N/A	N/A	4.5 - 7.5	3,900	3,000
B or B(AE)		0.62	N/A	N/A	N/A 3.0 - 6.0	3,250	2,500

Table 2 Notes:

- * Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.
- ** For f'_c over 4,000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria. Use air content percent in Table 2 for these mixes according to the class specified and the coarse aggregate size.
- *** For Class AA(ES), achieve at least 3,000 psi at 24 hr.

- B. Maximum nominal size of coarse aggregate:
1. Not larger than $\frac{1}{5}$ the narrowest dimension between sides of forms.
 2. Not larger than $\frac{1}{3}$ the depth of slabs.
 3. Not larger than $\frac{3}{4}$ the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.
- C. Do not exceed water/cementitious ratio.
1. Calculate the water/cementitious ratio (w/c) by weight according to the following formula:

$$\frac{w}{c} = \frac{\text{Water}}{\text{Cement} + \text{Pozzolan}}$$

- D. Do not exceed 30 percent total pozzolan in any mix unless approved or otherwise specified.
- E. Use 94 lb additional cementitious material per cubic yard to the amounts determined in the mix design for concrete deposited in water.
- F. Slump tolerance
1. Establish the target slump by mix design trial batch.
 2. The target slump tolerance is the acceptable variation from the maximum target slump.
 3. Do not exceed a 9 inch slump.

Table 3

Target Slump Tolerance (inch)		
	Target Slump	
	3 inches or less	More than 3 inches
Plus tolerance	0	0
Minus tolerance	1 ½ inches	2 ½ inches

2.2 MATERIALS

- A. Cement
1. Use Type II Portland Cement or equivalent according to Table 4 unless otherwise specified. Type III Portland Cement or equivalent may be used for precast items.
 2. Blended Hydraulic Cement
 - a. Blended hydraulic cement substituted for Portland Cement:
 - 1) Use ASTM C 1567 to verify that expansion is less than 0.1 percent 14 days after the zero reading.

- 2) Refer to the equivalent cements listed in Table 4.
- b. Do not exceed 30 percent total pozzolan limit when adding fly ash to a blended hydraulic cement.
 - 1) Submit documentation of the total pozzolan content with the mix design.

Table 4

Portland Cement/Blended Hydraulic Cement Equivalencies		
AASHTO M 85 (Low Alkali)	ASTM C 595	ASTM C 1157
*Type I	IP, IL, IT	GU
Type II	IP(MS), IT(MS)	MS
Type III	-	HE
*Type V	IP(HS), IT(HS)	HS

*Use only when specified

3. Do not mix cements originating from different sources.
4. Do not use air-entrained cement.

B. Aggregate

1. Coarse Aggregate
 - a. Use coarse aggregate that meets AASHTO M 80 physical properties. Use one of the gradations in Table 4.
 - b. Do not exceed percentages of deleterious substances as specified in AASHTO M 80, Table 2, for Class A aggregates.

Table 5

Coarse Aggregate Gradations - Percent Passing (by weight)									
Aggregate Size (inches or sieve size)	2½	2	1½	1	¾	½	⅜	No. 4	No. 200
2 to No. 4	100	95-100		35-70		10-30		0-5	0-1
1½ to No. 4		100	95-100		35-70		10-30	0-5	0-1
1 to No. 4			100	95-100		25-60		0-10	0-1
¾ to No. 4				100	90-100		20-55	0-10	0-1

2. Fine Aggregate
 - a. Use fine aggregate that meets AASHTO M 6 physical properties. Use the gradation in Table 5.

- b. Do not exceed percentages of deleterious substances as specified in AASHTO M 6, Table 2, for class A aggregates, using option “b” for material finer than the No. 200 sieve.

Table 6

Fine Aggregate Gradation	
Sieve Size	Percent Passing (by weight)
$\frac{3}{8}$ inch	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10
No. 200	0 to 3.0

3. A well-graded combined aggregate gradation may replace the gradation requirements in Tables 5 and 6.
 - a. Proportion combined aggregates using any combination of the 0.45 power chart, the 8-18 percent-retained and the Coarseness Factor charts in the UDOT Materials Manual of Instruction, Section 975: Guidelines for Well-Graded Combined Aggregate Gradations.
 - 1) Determine a combined gradation for the mix design. Provide targets for each sieve size ($\frac{3}{4}$ ", $\frac{1}{2}$ ", $\frac{3}{8}$ ", #4, #8, #16, #30, #50, #100)
 - 2) Maintain gradations within zone II of the coarseness factor chart.
 - 3) Allow a variance of sieve targets as determined by Table 7 for acceptance.

Table 7

Tolerances for a Well Graded Combined Aggregate Gradation	
Sieve Size	Percent Passing Allowable Tolerance
$\frac{3}{4}$ ", $\frac{1}{2}$ ", $\frac{3}{8}$ "	± 10%
#4, #8	± 5%
#16, #30, #50	± 4%
#100, #200	± 3%

- C. Water
 1. Use potable water or water that meets ASTM C 1602, including Table 2.
- D. Admixtures
 1. Do not use calcium chloride.
 2. Air Entrainment according to AASHTO M 154, including Section 5.

3. Water Reducing Agents
 - a. Refer to AASHTO M 194.
 - b. High Range Water Reducer (HRWR) – Submit a written plan for approval with the trial batch that details ingredients, production methods, handling, and placing.
4. Accelerators – Refer to AASHTO M 194.
5. Set Retarding and Hydration Stabilizing Admixtures – Refer to AASHTO M 194.
 - a. Establish and inform the Engineer of the effective life of the set-retarding or stabilizing admixture by trial batch if admixtures are required due to haul times exceeding the time limitations in this Section, Article 3.3, paragraph A.
 - b. Do not exceed manufacturer's recommendations for the use of the set retarding admixture.
 - c. Do not re-dose the concrete with additional set retarding admixture.
 - d. Add admixture at the batch plant at the time of initial batching operations.
 - e. Show on batch tickets the amount of admixture used.
 - f. Time of placement is established by the trial batch and supersedes the requirements in this Section, Article 3.3, paragraph A.
6. Site-added air-entrainment – Refer to AASHTO M 154.
 - a. Limit the use of site-added air-entraining agents to one addition per load, regardless of quantity.
 - b. Use pre-measured admixtures.
 - c. Record amount used on batch ticket.
 - d. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

E. Pozzolan

1. Fly Ash
 - a. Class F according to AASHTO M 295 except Table 2.
 - 1) Loss on Ignition (LOI) Not to exceed 3 percent.
 - 2) Allowable CaO content Not to exceed 15 percent.
 - 3) Label the storage silo for fly ash to distinguish it from cement.
 - 4) Use different size unloading hoses and fittings for cement and fly ash.
2. Natural Pozzolan (Class N)
 - a. Refer to AASHTO M 295.
 - b. May use instead of fly ash provided that the expansion does not exceed 0.1 percent. Refer to ASTM C 1567.
3. Silica Fume
 - a. Refer to AASHTO M 307.

2.3 MIX DESIGN

- A. Design mixes to meet the requirements of this Section and project specific criteria.
- B. The Contractor assumes responsibility for the compatibility of admixtures with the mix design and their potential effects on concrete properties.
- C. Design the cementitious system to mitigate potential alkali-aggregate reactivity.
 - 1. Use at least 20 percent pozzolan by weight of the total cementitious system.
- D. Obtain approval from the Engineer for the project specific application of an approved mix design.

2.4 TRIAL BATCHES

- A. Use the same components in the trial batches that will be used in the project.
 - 1. Accelerators and site-added air-entrainment can be incorporated in the trial batch but are not required.
- B. Use Department certified TTQP Concrete and Concrete Strength Testing personnel to perform trial batches and strength tests.
- C. The Department or its certified representative may witness the trial batch.
- D. Mix concrete trial batches according to the UDOT Materials Manual of Instruction 974: Guidelines for Portland Cement Concrete Mix Design Trial Batches.
- E. Use a Department qualified laboratory to verify trial batch compressive and flexural strength testing.

2.5 AGGREGATE STOCKPILES

- A. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.
- B. Build stockpiles at least two days before use.
- C. Provide an operator and front-end loader to help the Engineer take aggregate samples.

- D. Provide separate stockpiles for coarse and fine aggregates.
- E. Construct stockpiles to minimize segregation of aggregates
- F. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

2.6 BATCH MATERIALS

- A. Batch Tolerances. Refer to AASHTO M 157.
 - 1. Cementitious Material : ± 1 percent of the required mass
 - 2. Aggregate: ± 2 percent of the required mass
 - 3. Total Water: ± 3 percent of the required mix amount
- B. Truck-Mixed Concrete (Dry-Batch)
 - 1. Do not load trucks in excess of their rated mixing capacity, 63 percent of the drum gross volume, or less than 2 yd³.
 - 2. The truck rating plate must be readable.

PART 3 EXECUTION

3.1 LIMITATIONS

- A. Timing – Deliver, place, and consolidate concrete as follows unless otherwise specified:
 - 1. Within 90 minutes of batching when the air temperature is below 80 degrees F.
 - 2. Within 75 minutes of batching when the air temperature is between 80 and 85 degrees F.
 - 3. Within 60 minutes of batching when the air temperature is above 85 degrees F.
- B. Concrete Temperature – Place concrete when the concrete temperature is between 50 and 90 degrees F unless otherwise specified.
- C. Pumping and Conveying Equipment
 - 1. Do not use equipment or a combination of equipment and the configuration of that equipment that causes a loss of entrained air content that exceeds $\frac{1}{2}$ of the range of air content allowed by specification.
 - 2. Contractor is responsible to verify and monitor air loss.
 - 3. Replace, reconfigure, or repair equipment that does not meet the requirements of this Section, Article 3.1, paragraph C1

- D. Cold Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to cold weather during the protection period. Cold weather applies when the temperature is forecast to fall below 35 degrees F during the protection period.
1. Provide necessary cold weather protection for placing, finishing, curing and protecting in-place concrete such as covers, insulation, and heat.
 - a. Follow the authorized Cold Weather Concreting Plan when placing cast-in-place concrete.
 - b. Follow the prequalified supplier's approved Quality Control Plan when fabricating precast concrete members.
 2. Concrete materials
 - a. Do not use chemical anti-freeze additives in the concrete. This does not apply to normal accelerators. Refer to AASHTO M 194.
 - b. Remove and replace concrete damaged by frost action at no additional cost to the Department.
 - c. Do not use material containing frost or lumps.
 3. Determine the concrete compressive strength by one of the following methods:
 - a. Field cured cylinders cured and protected the same as the concrete being protected.
 - b. Maturity method. Refer to AASHTO T 325.
 4. Maintain the temperature of the concrete at or above 50 degrees F during and after placement until the end of the protection period.
 - a. Measure the specified concrete temperature at the concrete surface. Use surface thermometers insulated from the surrounding air.
 5. Placing concrete
 - a. Do not place concrete during adverse weather including rain, snow, and high winds without adequate protection approved by the Engineer.
 - b. Do not proceed with the placement of concrete if the temperature of all contact surfaces, including reinforcement, is less than 36 degrees F or greater than 95 degrees F.
 - c. Cease placement operations when the ambient temperature is 40 degrees F and decreasing unless adequate precautions are taken according to the approved Cold Weather Concreting Plan.
 6. Protection of in-place concrete
 - a. Maintain the concrete above 50 degrees F during placement and until the end of the protection period.
 - 1) The protection period is the time required for the concrete to reach a compressive strength of at least 3,500 psi.

- 2) Extend the duration of the protection period at least 24 hr beyond the termination of the cure before exposing the concrete to freezing temperatures when curing by the water method. Refer to Section 03390.
 - b. Comply with the following when heating is required.
 - 1) Adequately vent combustion-type heaters that produce carbon monoxide.
 - 2) Position heaters and ducts so the hot dry air does not cause areas of the concrete surface to overheat or dry.
 - 3) Keep concrete surfaces moist to avoid excessive loss of moisture from the concrete when applying external heat.
 7. Termination of protection
 - a. Limit the drop in temperature of concrete surfaces to 40 degrees F during any 24 hour period when removing cold weather protection until the surface temperature of the concrete reaches that of the ambient air temperature.
- E. Hot Weather – Comply with the following when placing, finishing, curing, and protecting concrete exposed to hot weather during the protection period.
1. Hot weather limitations apply at any time of the year when a combination of high ambient temperature, high concrete temperature, low relative humidity, and high wind speed have the potential to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and the rate of cement hydration, or otherwise causes detrimental results.
 2. Monitor site conditions, including air temperature, relative humidity, and wind speed, to assess the need for evaporation control measures.
 - a. Begin monitoring no later than 1 hour before beginning concrete placing operations.
 - b. Continue to monitor site conditions at intervals of 20 minutes or less until required curing procedures are applied.
 3. Provide necessary hot weather protection.
 - a. Follow the approved Hot Weather Concreting Plan when placing cast-in-place concrete.
 - b. Follow the prequalified supplier's approved Quality Control Plan when fabricating precast concrete members.

- c. Initiate evaporation control measures when concrete and air temperatures, relative humidity of the air, and wind speed have the capacity to evaporate free water from the fresh concrete surface at a rate equal to or greater than 0.2 lb/ft²/hr.
 - 1) Determine the evaporation rate of surface moisture using the NRMCA Nomograph in Appendix B of ACI 305.1.
- 4. Cool all surfaces that will come in contact with the concrete to below 95 degrees F

3.2 CYLINDER STORAGE DEVICE

- A. Provide and maintain cylinder storage device.
 - 1. Maintain cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 16 hour curing period.
 - 2. Do not move the cylinders during this period.
 - 3. Equip the storage device with an automatic 24 hour temperature recorder that continuously records on a time/temperature chart with an accuracy of ± 1 degree F.
 - 4. Have the storage device available at the point of placement at least 24 hours before placement.
 - 5. Stop placement of concrete if the storage device is not provided or cannot accommodate the required number of test cylinders. Cylinder strength results may not be disputed if storage devices are not provided.
 - 6. Use water containing hydrated lime if water is to be in contact with cylinders.
 - 7. The Engineer may require a 24 hour test run to determine the storage device capability to maintain and record temperature.

END OF SECTION

SECTION 03056

SELF-CONSOLIDATING CONCRETE (SCC)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-consolidating concrete.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 6: Fine Aggregate for Portland Cement Concrete
- B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete
- C. AASHTO T 347: Slump Flow of Self-Consolidating Concrete (SCC)
- D. AASHTO T 345: Passing Ability of Self-Consolidating Concrete (SCC) by J-Ring
- E. AASHTO T 351: Visual Stability Index (VSI) of Self-Consolidating Concrete (SCC)
- F. ASTM C 494: Chemical Admixtures for Concrete
- G. ASTM C 1602: Mixing Water Used in the Production of Hydraulic Cement Concrete
- H. ASTM C 1610: Static Segregation of Self-Consolidating Concrete Using Column Technique
- I. American Concrete Institute (ACI) Standards
- J. UDOT Materials Manual of Instruction
- K. UDOT Minimum Sampling and Testing Requirements
- L. UDOT Quality Management Plans

1.4 DEFINITIONS

- A. Self-Consolidating Concrete (SCC) – A highly flowable non-segregating concrete mix that spreads into place, and is able to flow and fill all corners of the formwork, even in the presence of congested reinforcement by means of its own mass with no mechanical vibration.

PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

- A. Refer to Section 03055, except as modified in this Section.
- B. Slump Flow – 18 to 32 inches. Refer to AASHTO T 347.
- C. Visual Stability Index rating 0 – 1. Refer to AASHTO T 351.
- D. Static Segregation – less than 10 percent. Refer to ASTM C 1610.
- E. Passing Ability of Self-Consolidating Concrete (SCC) by J-Ring
Refer to AASHTO T 345
- F. Do not exceed water/cementitious ratio of 0.40.

2.2 MATERIALS

- A. General
 - 1. Refer to Section 03055, except as modified in this Section.
- B. Aggregate
 - 1. Use Coarse Aggregate according to AASHTO M 80 physical properties and the combined aggregate gradation requirements of Table 1.
 - a. Do not exceed percentages of deleterious substances as shown in AASHTO M 80, Table 2, for Class A aggregates.

2. Use Fine Aggregate according to AASHTO M 6 physical properties and the combined aggregate gradation requirements of Table 1.
 - a. Do not exceed percentages of deleterious substances according to AASHTO M 6 for class A aggregates, using class B for material finer than the No. 200 sieve.

Table 1

Combined Aggregate Gradations Percent Passing by Dry Weight of Aggregate		
Sieve Size	$\frac{3}{4}$ inch Operating Bands	$\frac{1}{2}$ inch Operating Bands
$\frac{3}{4}$ inch	95 – 100	–
$\frac{1}{2}$ inch	65 – 95	95 – 100
$\frac{3}{8}$ inch	58 – 83	65 – 95
No. 4	35 – 65	50 – 80
No. 8	25 – 50	30 – 60
No. 16	15 – 35	20 – 45
No. 30	10 – 35	12 – 35
No. 50	5 – 20	5 – 20
No. 100	1 – 12	2 – 12
No. 200	0 – 5	0 – 5

- C. Water
 1. Use potable water or water according to ASTM C 1602, including Table 2.
- D. Admixtures
 1. Viscosity Modifying Admixtures (VMA) according to ASTM C 494, Type S.
 - a. Do not exceed manufacturer's recommendations for the use of the viscosity modifying admixture.
 - b. Show the amount of admixture used on batch tickets.
 - c. Do not allow site-added VMA

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to Section 03055

END OF SECTION

SECTION 03057

STRUCTURAL CONCRETE – LIGHTWEIGHT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural lightweight concrete using lightweight aggregate for the coarse aggregate portion of the mix.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 195: Lightweight Aggregates for Structural Concrete
- B. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- C. AASHTO T 121: Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- D. AASHTO T 196: Air Content of Freshly Mixed Concrete by the Volumetric Method
- E. ASTM C 567: Determining Density of Structural Lightweight Concrete
- F. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS

- A. Structural Lightweight Concrete – A lightweight portland cement concrete mix (used to reduce the dead load of the structure) with all of the attributes and performance equal to normal weight structural concrete and with a lower unit weight.

1.5 SUBMITTALS

- A. Refer to Section 03055, except as modified in this Section.
 - 1. Include in the concrete mix design submittal in addition to the requirements in Section 03055:
 - a. The weight and absolute volume for each component.

- b. The unit weight of the fresh concrete mix for the purposes of acceptance.
- c. Test reports showing that the equilibrium density of the concrete mix meets the requirements of this Section, Article 2.1 Paragraph B.

1.6 ACCEPTANCE

- A. Acceptance is according to Section 03055 and the UDOT Minimum Sampling and Testing Requirements.
 - 1. Air content will be determined by AASHTO T 196.
 - 2. Density/unit weight of fresh concrete with each air content determination. Refer to AASHTO T 121.

PART 2 PRODUCTS

2.1 GENERAL

- A. Refer to Section 03055, except as modified in this Section.
- B. Keep the equilibrium density of the mix between 110 to 115 lb/ft³ as determined according to ASTM C 567.
- C. Do not allow the unit weight of the fresh concrete to vary more than ± 4 lb/ft³ from the target density for fresh concrete established by the mix design for field acceptance.
- D. Aggregates
 - 1. Coarse Aggregate
 - a. Meet the requirements of AASHTO M 195.
 - 1) Meet AASHTO M 195 Table 1, gradation band $\frac{1}{2}$ inch to #4 or $\frac{3}{4}$ inch to #4.
 - b. Use lightweight aggregates that have not more than 5 percent loss, when tested for soundness using Magnesium Sulfate (5 cycles). Refer to AASHTO T 104.
- E. Mix Design
 - 1. Base the mix design on the recommendations of the lightweight aggregate manufacturer for each combination of materials to be used.
- F. Aggregate Stockpiles
 - 1. Uniformly pre-wet or pre-saturate the aggregates in such a manner that uniform penetration of the concrete will be maintained.

- G. Batch Materials
 - 1. Batch lightweight coarse aggregate either by weight or by volume. Equip the batching equipment if by volume such that the weight of each size of aggregate in the batch can be verified.
 - 2. Verify each load using batched weights of materials.

PART 3 EXECUTION

3.1 GENERAL

- A. Refer to Section 03055.

END OF SECTION

SECTION 03139

CONCRETE BRIDGE DECK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete bridge deck removal in preparation for replacing the entire bridge deck.

1.2 RELATED SECTIONS

- A. Section 03924: Structural Concrete Repair

1.3 REFERENCES

- A. AASHTO/AWS D1.5 Bridge Welding Code
- B. AASHTO LFRD Bridge Design Specifications

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Bridge Deck Removal Plan for review including at least the following:
 - a. The proposed method of deck removal.
 - b. Precautions that will be used to protect portions of the structure to remain.
 - c. Written sequence of the specific steps for demolition.
 - 1) Include steps to remove the bridge deck in a safe and controlled manner.
 - d. Work area plan.
 - 1) Depict items such as utilities overhead and below the work area, drainage inlet structures, and protective measures.
 - e. Details of deck removal equipment and locations of use.
 - 1) Include details of equipment used to lift large portions of the deck such as cranes, excavators, lifting slings, sling hooks, and jacks.
 - a) Include crane locations, operation radii, and lifting calculations.

- f. Methods for preventing damage and containing debris to protect adjacent travelways, railroad facilities, waterways, property, utilities, and areas of the environment specified for protection.
 - 1) Include details and locations of protection and containment such as debris shields.
- g. Supporting engineering calculations.
 - 1) Demonstrate the satisfactory stability and strength of the bridge under all anticipated loads and removal methods.
 - a) Account for the loss of composite action as the bridge deck is being removed.
 - b) Consider the AASHTO LRFD dynamic load allowance.
 - 2) Demonstrate adequate strength for debris shields and containment.
- h. Procedures for repairing girder damage such as cuts, nicks, gouges, dents, and spalls.
 - 1) Refer to this Section, Article 3.2.
- i. Weld repair procedures meeting the requirements of AASHTO/AWS D1.5.
 - 1) Include weld testing and grinding requirements.
- j. Methods of debris disposal from the deck removal including final disposal site.
- k. Schedule
 - 1) Comply with all construction timeframes specified.
- l. The seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah on drawings and calculations.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Saw Cutting Equipment
 - 1. Use saws capable of cutting through concrete and reinforcing steel to the specified depth.
- B. Machine Mounted Hydraulic or Pneumatic Equipment
 - 1. May be used to remove sidewalks, curbs, barriers, and railings that do not rest directly over girders or diaphragms.
 - 2. May be used in those areas of the bridge deck between the girders.
 - a. Do not use directly over or within 1 ft of any portion of the girders or diaphragms.

- C. Jackhammers
 - 1. Use jackhammers to remove portions of concrete decks, sidewalks, curbs, barriers and railings that rest directly on top of girders or diaphragms.
 - 2. Limit the capacity of jackhammers within 6 inches of the existing girders or diaphragms.
 - a. Use 90 lb or smaller jackhammers.
 - b. Reduce the capacity of jackhammers if damage occurs to the girders or diaphragms.
- D. Hand Held Cutting Tools
 - 1. Use cutting torches to cut existing reinforcing steel and shear connectors that are required to be removed.
 - 2. Use hand-held grinding equipment to remove portions of shear connectors.
- E. Other Equipment
 - 1. Do not use unless authorized in the Bridge Deck Removal Plan.

PART 3 EXECUTION

3.1 DECK REMOVAL

- A. Follow the authorized Bridge Deck Removal Plan.
- B. Provide the necessary equipment and protective shields to prevent damaging items below and adjacent to the bridge.
 - 1. This includes the collection of water used during deck removal.
 - 2. Use debris shields and containment without cracks and openings through which material may pass.
- C. Inspection.
 - 1. Provide equipment that will facilitate inspection.
 - 2. Notify the Department Steel Inspector 7 calendar before the first stages of bridge deck removal.
 - 3. Notify the Engineer of any damage to girders.
- D. Saw Cutting.
 - 1. Limit the depth of longitudinal and transverse saw cuts above the girder top flange to just below the bottom mat of reinforcing steel but not closer than 2 inches to the flange, splice plate or bolts.
 - a. Saw cuts no closer than 1 inch are permitted when bottom mat of reinforcing steel is closer than 2 inches to the top flange, splice plate or bolts. Coordinate the saw cuts that are closer than 2 inches to the flange, splice plates, or bolts with the Engineer.

2. Continuously monitor the extension of the saw blade from under the deck during the cutting operation to prevent cutting into the girder top flanges.
 3. Maintain radio or visual contact between the monitoring personnel and the cutting crew.
 4. Mark deck surface above steel girder splice locations to avoid cutting concealed splice plates and bolts.
- E. Remove the concrete over the girder flange with jackhammers.
1. Provide alternate methods of concrete removal in the Bridge Deck Removal Plan.
 2. Modify the removal process if damage occurs to the top flange, diaphragms, splice plates, or bolts.
- F. Remove shear studs on steel girders as shown.
1. Remove sufficient length to avoid conflict with new deck reinforcing steel and shear studs.
 - a. Remnants up to $\frac{3}{4}$ inch may be left in place if there is no conflict.
 - b. Do not damage flange if grinding smooth to top flange.
- G. Protect stirrups in concrete girders in place.
1. Repair damaged stirrups as authorized by Engineer.
- H. Clean top surfaces of girders.
1. Remove concrete, rust scale or other extraneous material from steel girders.
 2. Remove fractured and loose concrete from concrete girders.

3.2 REPAIR DAMAGED STRUCTURE MEMBERS

- A. Repair damaged girders and diaphragms according to the authorized Bridge Deck Removal Plan. Use the following to develop the repair procedures:
1. Identify positive and negative moment regions.
 2. Steel girder bridges
 - a. Repair bends and dents larger than $\frac{1}{2}$ inch according to the authorized Bridge Deck Removal Plan.
 - 1) Smaller bends and dents need not be repaired.

- b. Repair cuts, nicks and gouges less than or equal to $\frac{1}{16}$ inch deep for negative moment regions, and less than or equal to $\frac{3}{16}$ inch deep for positive moment regions, by grinding; unless the damaged area reduces the total flange cross section by more than 2 percent.
 - 1) Notify Engineer if damage is deeper than $\frac{1}{16}$ inch for negative moment regions, and deeper than $\frac{3}{16}$ inch for positive moment regions, or total flange cross section has been reduced by more than 2 percent.
 - c. Repair cuts, nicks and gouges greater than $\frac{1}{16}$ inch deep for negative moment regions, and greater than $\frac{3}{16}$ inch deep for positive moment regions, according to the method described in the Bridge Deck Removal Plan.
 - d. Repair damaged webs, transverse vertical stiffeners, and connection plates.
- 3. Concrete Girder Bridges
 - a. Repair spalls $1\frac{1}{2}$ inch or greater using an authorized patching material
 - 1) Spalls less than $1\frac{1}{2}$ inch in the top flange need not be repaired provided that the area is to be filled with concrete or grout in the completed bridge deck.
 - b. Repair cracks in the top flange using epoxy injection crack repair methods according to Section 03924.
 - c. Repair saw cuts that are deeper than $\frac{1}{4}$ inch by chipping out the area and patching with an approved patching material.
 - 1) Smaller saw cuts need not be repaired.
- 4. Develop special repair procedures for situations not defined in the authorized Bridge Deck Removal Plan and obtain authorization before starting the repair procedure.

END OF SECTION

SECTION 03152

CONCRETE JOINT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joint Filler and Joint Sealer
- B. Backer Rods and Waterstops

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- B. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- C. AASHTO LRFD Bridge Construction Specifications
- D. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete
- E. ASTM C 509: Elastomeric Cellular Preformed Gasket and Sealing Material
- F. ASTM C 639: Rheological (Flow) Properties of Elastomeric Sealants
- G. ASTM C 661: Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
- H. ASTM C 679: Tack-Free Time of Elastomeric Sealants
- I. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
- J. ASTM C 793: Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
- K. ASTM C 794: Adhesion-in-Peel of Elastomeric Joint Sealants

- L. ASTM C 920: Elastomeric Joint Sealants
- M. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
- N. ASTM D 792: Density and Specific Gravity (Relative Density) of Plastics by Displacement
- O. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics
- P. ASTM D 1622: Apparent Density of Rigid Cellular Plastics
- Q. ASTM D 1623: Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
- R. ASTM D 6690: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- S. Federal Specifications
- T. Military Specifications (MIL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 HOT POURED JOINT SEALANT

- A. Refer to ASTM D 6690, Type II for general requirements, physical properties, packing, marking, and sampling.

2.2 PREMOLDED JOINT FILLERS

- A. Refer to AASHTO M 153
- B. Refer to AASHTO M 213.

2.3 SILICONE JOINT SEALER

- A. Silicone joint sealer and special category for self-leveling.
 - 1. Both made of low-modulus silicone specifically formulated to seal portland cement concrete pavement joints.
- B. Furnish in a one-part, non-acid curing formulation. Refer to ASTM C 309.
- C. Meet the requirements in Table 1 for Silicone joint sealer and Table 2 for Self-leveling silicone joint sealer.

Table 1

Requirements (Silicone Joint Sealer)		
Description	Requirement	Test Method
Tensile Stress –150 percent max elongation, 7-day cure at 77 ± 3 degrees F and 45-55 percent relative humidity (rh).	45 psi maximum	ASTM D 412 (DIE C)
Flow	0.3 inch maximum	MIL-S-8802
Extrusion Rate 100 degrees to 0 degrees F	0.2 - 0.6 lbs/min	MIL-S-8802
Tack-Free Time	20 - 75 minutes	MIL-S-8802
Specific Gravity	1.01 - 1.51	ASTM D 792
Durometer Hardness, shore A – cured 7 days at 77 ± 3 degrees F and 45-55 percent relative humidity (rh).	10 - 25	ASTM C 661
Shelf Life	6 month minimum from date of shipment from plant or point of manufacture.	
Ozone and Ultraviolet (UV) Resistance	No chalking, cracking, or bond loss.	ASTM C 793
Movement capability and adhesion. Magnitude of cycles movement is appropriate for sealant category, cure 7 days in air 77 ± 3 degrees F then 7 days in water 77 ± 3 degrees F.	No Failures	ASTM C 719

Table 2

Requirements for Self-Leveling (Silicone Joint Sealer)		
Description	Requirement	Test Method
Rheological Properties – Type I	Pass	ASTM C 639
Elongation, percent minimum	800 %	ASTM D 412 DIE C, Mod.
Tensile Stress at 150 percent Elongation	40 psi maximum	ASTM D412
Accelerated Weathering	No chalking, cracking, or bond loss	ASTM C793
Shelf Life	Six month min. from date of shipment from plant or point of manufacture.	
Durometer Hardness, Shore OO – cured 14 days at 77 ± 3 degrees F and 45 - 55 percent, rh	40-80	ASTM C661
Movement capability and adhesion. Magnitude of cycles movement is appropriate for sealant category, cure 14 days in air 77 ±3 degrees F, and then 7 days in water 77 ±3 degrees F	No failures	ASTM C719

- D. Sealant must be delivered in the manufacturer's original sealed container, displaying the lot number, expiration date of the shelf-life warranty, and the sealer trade name.

2.4 BACKER ROD

- A. Use closed-cell, polyethylene-foam rods that meet the requirements in Table 3.

Table 3

Backer Rod Requirements and Test Methods		
Description	Requirement	Test Method
Diameter	Joint width + 1/8 inch	
Density	2 lbs/ft ³	ASTM D 1622
Tensile Strength	25 psi	ASTM D 1623
Absorption	0.5 % by volume	ASTM C 509
Compression	25 percent at 8 psi	ASTM D 1621
Deflection		ASTM D 1621

2.5 JOINT SEALER (STRUCTURES)

- A. Cold-applied, gun-grade, single-component, polyurethane base material that cures under field condition to form a rubber-like, non-sag, elastomeric joint seal as specified in Federal Specifications TT-S-00230 C, Type II, Class A and ASTM C 920, Type S, Grade NS, Class 35, Use T, NT, O, M, G, I.
- B. Use material that bonds tightly to the sides of the concrete groove and exhibits the physical properties in Table 4 when cured and tested after 21 days at 73 degrees F.

Table 4

Physical Properties of Joint Sealer (Structures) and Test Methods		
Description	Requirement	Test Method
Modulus of Elasticity at 100 percent Elongation	65 psi minimum	ASTM D 412
Hardness (Shore A)	35 ± 5	ASTM C 661
Elongation (at break)	300 % minimum	ASTM D 412
Tensile Strength	175 psi minimum	ASTM D 412
Adhesive-in-Peel	20 lbs/linear inch (pli)	ASTM C 794
Service Temperature Range	-20 °F to 180 °F	TT-S-00230 C
Tack Free Time	72 hours maximum	ASTM C 679
Final Cure	5 to 8 days	ASTM C 679
Staining Characteristics	Non-staining	
Color	Gray	

2.6 WATERSTOPS

- A. Refer to AASHTO LRFD Bridge Construction Specifications, Section 8.9.2.6

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 03211

REINFORCING STEEL AND WELDED WIRE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel, steel welded wire reinforcement, dowelled anchors, T-headed bars, mechanical couplers, and grouted splice couplers.
- B. Coating for reinforcing steel, steel welded wire reinforcement, and dowelled anchors.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. AASHTO M 55: Steel Welded Wire Reinforcement, Plain, for Concrete
- C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. AASHTO M 235: Epoxy Resin Adhesives
- E. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in Cube Specimens)
- F. ASTM A 108: Steel Bar, Carbon and Alloy, Cold-Finished
- G. ASTM A 493: Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- H. ASTM A 706: Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- I. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- J. ASTM A 775: Epoxy-Coated Steel Reinforcing Bars
- K. ASTM A 934: Epoxy-Coated Prefabricated Steel Reinforcing Bars

- L. ASTM A 955: Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement
- M. ASTM A 970: Headed Steel Bars for Concrete Reinforcement
- N. ASTM E 1512: Testing Bond Performance of Bonded Anchors
- O. American Welding Society (AWS) Standards
- P. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings for review of the following:
 - a. Field bending procedure if required. Provide the seal of a Professional Engineer (PE) or Professional Structure Engineer (SE) licensed in the State of Utah.
 - b. Mechanical butt splice shop drawings when proposed details differ from the plans and specifications.
 - 1) Show number and location of mechanical butt splices.
 - 2) Provide two samples of mechanical butt splices and test to destruction in the presence of the Engineer.
- B. Material Submittals
 - 1. Certificates of Compliance from the manufacturer.
 - 2. Samples for verification testing to meet the testing requirements of AASHTO M 31, ASTM A 706, and ASTM A 955, respectively.
 - 3. Continuous butt welded reinforcing hoops.
 - a. Manufacturer's Quality Control (QC) procedures for the hoop fabrication for review. Include the following as a minimum:
 - 1) The pre-production procedures for the qualification of material and equipment.
 - 2) The methods and frequencies for performing QC procedures during production.
 - 3) The calibration procedures and calibration frequency for all equipment.
 - 4) The welding procedure specification (WPS) for resistance welding.
 - 5) The method for identifying and tracking lots.
 - b. Two samples of welded splices for verification testing.

4. Grouted Splice Couplers
 - a. Independent test report confirming coupler compliance for each supplied coupler size with the following:
 - 1) Develop 150 percent of the specified yield strength of the connected bar.
 - 2) Determine by testing the amount of time and grout compressive strength required to provide 100 percent of the specified minimum yield strength of the attached reinforcing bar. Use this value to determine when to release bracing.
 - 3) Use the same grout in the testing that will be used in the construction.
 - 4) Requirements for the grout including required strength gain to develop the specified minimum yield strength of the connected reinforcing bar.
5. Epoxy adhesive material data sheet and recommended installation instructions.

1.6 QUALITY ASSURANCE

- A. The Department may witness coating processes for project work.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

- A. Deformed or plain carbon steel bars.
 1. Refer to AASHTO M 31, Grade 60.
- B. Deformed or plain low-alloy steel bars.
 1. Refer to ASTM A 706, Grade 60.
- C. Deformed or plain stainless steel bars.
 1. Refer to ASTM A 955, Type XM-28.

2.2 WIRE AND WIRE REINFORCEMENT

- A. Refer to AASHTO M 55 for cold drawn steel wire.
- B. Refer to AASHTO M 55 for steel welded wire reinforcement.

2.3 T-HEADED BARS

- A. Use T-headed bars consisting of deformed rebar with steel plates friction welded to one end of the rebar. Friction welding conforms to the authorized quality control manual and AWS C6.2, Friction Welding of Metals.
 - 1. Headed Bars that meet the requirements of ASTM A 970 may be substituted.
- B. Use deformed rebar according to ASTM A 706, Grade 60.
- C. Cut plate heads for T-headed bars from flats of hot-rolled steel according to ASTM A 108.

2.4 COATINGS

- A. Epoxy Coating.
 - 1. Refer to ASTM A 775 or ASTM A 934.
- B. Galvanized Coating.
 - 1. Refer to AASHTO M 111.
- C. Coat bars as described.
 - 1. Maintain epoxy coating thickness between 8 and 12 mils.
 - 2. Maintain galvanized coating thickness according to ASTM A 767.
 - 3. Coat bars after bending unless the fabricator can show that satisfactory results can be obtained by coating before bending.
 - 4. Do not use bent bars with visible cracks or damage in the coating.

2.5 DOWELLED ANCHORS

- A. Use epoxy resin adhesive according to AASHTO M 235, Type V, Grade 3.
- B. Use reinforcing steel, bolts, and anchors as shown.

2.6 BAR SUPPORTS AND TIE WIRE

- A. Provide epoxy coated, galvanized, plastic coated, or plastic bar supports and tie wire for reinforcing steel other than stainless steel that meet the following requirements:
 - 1. Meet the requirements of Table 1.
 - 2. Remove contaminants that affect the adhesion of the coating to the wire.
 - 3. Use an electrostatic spray method, fluidized bed, or flocking to apply an epoxy coating.

4. Apply plastic coating by spraying, dipping, or using as a powder.
 5. Galvanized coating thickness is according to AASHTO M 111.
 6. Maintain the thickness of epoxy or plastic coatings of at least 5 mils with no maximum.
 7. Use patching material according to the manufacturer's recommendation to repair damaged coating.
 - a. Use patching material that is compatible with the coating and that is inert in concrete.
 - b. Do not repair hanger marks on the coated bar supports that result from the coating application process. Hanger marks are not considered damaged coating.
 8. Use 16 gauge coated tie wire.
- B. Precast concrete block bar supports that conform to the following:
1. Provide minimum 28-day compressive strength of 2,500 psi.
 2. Use three inch thick supports with sides ranging from 4 to 6 inches with a minimum contact area of 24 in².
- C. Provide bar supports and tie wires for use with stainless steel bars that meet the following:
1. Meet the requirements of Table 1.
 2. Provide bar supports that are plastic or stainless steel conforming to the requirements of ASTM A 493, Type 316.
 3. Provide tie wires that are plastic or stainless steel conforming to the requirements of ASTM A 493, Type 316, annealed.

2.7 MECHANICAL SPLICE COUPLER

- A. Service strength bars:
1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 125 percent of the specified yield strength of the reinforcing bar.
- B. Ultimate strength bars:
1. Use where shown.
 2. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 150 percent of the specified yield strength of the reinforcing bar.
- C. Coat the coupler with the same coating as the reinforcing steel being spliced.
- D. Use stainless steel splice coupler with stainless steel reinforcement.

2.8 GROUTED SPLICE COUPLER

- A. Use grouted splice couplers to join precast elements as shown.
 - 1. Provide couplers that use cementitious grout placed inside a steel casting. Grout is part of the proprietary system and is provided by the coupler manufacturer.
 - 2. Use threaded connections at the Contractor's option for the portions of the coupler that are placed within the precast element if the strength of the coupler meets or exceeds the requirements of this Section.
- B. Use one of the following grouted splice coupler manufacturers according to the requirements of this Section. Refer to <http://www.udot.utah.gov/go/standardsreferences> for information on the following providers:
 - 1. NMB Splice Sleeve
Splice Sleeve North America, Inc.
38777 West Six Mile Road, Suite 205
Livonia, MI 48152
 - 2. Sleeve-Lock Grout Sleeve System
Dayton Superior Corporation
1125 Byers Road
Miamisburg, OH 45342
 - 3. Lenton Interlok
Pantair USA
34600 Solon Road
Solon, OH 44139
- C. Use grouted splice couplers that provide 150 percent of the specified yield strength of the connected bar.
- D. Use grout supplied by the manufacturer of the coupler and that matches the certified test report for the coupler.
- E. Use the same coating system as used for the reinforcing steel.
 - 1. Use grouted splice couplers that join the reinforcing steel without removal of the epoxy coating on the spliced bar when using epoxy coated reinforcing steel.

2.9 CONTINUOUS RESISTANCE BUTT WELDED HOOPS

- A. Weld only reinforcing steel conforming to ASTM A 706 as shown.
 - 1. Use butt welded splices for continuous hoops.
- B. Refer to AWS D1.4: Structural Welding Code - Reinforcing Steel.

- C. Perform welding only by an AWS certified welder.
- D. Change welding procedures to reflect chemical composition of the steel.
 - 1. Welders must have correct mill test report (chemical analysis) from the heat in which the steel was made.
- E. Use only a welded splice capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other.
- F. Apply coating after all welding has been completed.

2.10 FABRICATION

- A. Use Department Prequalified Suppliers for all reinforcing steel products.
- B. Bend reinforcement to the shapes as shown. Refer to CRSI Manual of Standard Practice.
- C. Do not heat the bars during the bending operations.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Protect the bars and the coating during handling and storage.
 - 1. Use systems with padded contact areas when handling epoxy coated bars.
 - 2. Pad all bundling bands for epoxy coated bars.
 - 3. Lift all bundles with strong-back, multiple supports, or a platform bridge.
 - 4. Do not drop or drag bars.
- B. Repair damaged coating.
 - 1. Epoxy Coated
 - a. Meet requirements of ASTM A 775 Appendix A.2 for repair material.
 - b. Follow manufacturer recommendations for repairs.
 - c. Do not use bars with total damaged surface area of epoxy coating greater than 2 percent in any 1 ft section.
 - d. Do not use bars with 5 percent or greater damage to total surface area during all stages of work.
 - 2. Galvanized
 - a. Use Inorganic Zinc Rich Paint with 65 to 69 percent zinc by weight or greater than 92 percent by weight metallic zinc in dry film for repair material.

- b. Follow manufacturer recommendations for repairs.
 - c. Reject bars with total damaged surface area of coating greater than 2 percent in any 1 ft section.
 - d. Reject any bars with 5 percent or greater damage to total surface area during all stages of work.
- C. Store bars above the ground surface on wooden or padded supports.
 - 1. Place timbers between bundles when stacking is necessary.
 - 2. Space the supports close enough to prevent sags in the bundles.
- D. Cover epoxy coated reinforcing steel with an opaque covering upon delivery to the project site.
 - 1. Protect epoxy coated reinforcing steel that has been partially embedded in concrete or placed in formwork.
 - a. Cover with an opaque covering before 30 days exposure to sunlight.
 - 2. Place the opaque coverings to provide air circulation and prevent condensation on the reinforcing steel.
- E. Ship, handle, and store stainless reinforcing steel so it does not come in contact with carbon steel.
 - 1. Cover stainless reinforcing steel with tarps during outdoor storage.
 - 2. Separate bundles of stainless reinforcing steel from other types of reinforcing steel with wooden spacers.
 - 3. Store stainless reinforcing steel on wooden supports off the ground or floor.

3.2 PLACEMENT

- A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.
- B. Field bend bars according to the authorized field bending procedures.
- C. Place all reinforcement in designated position and securely hold in position while placing and vibrating concrete.
 - 1. Placing Tolerances
 - a. Decks or members 10 inches or less in thickness
 - 1) Cover: $-\frac{1}{8}$ inch, $+\frac{1}{4}$ inch.
 - 2) Longitudinal spacing for individual bars: ± 1 inch.
 - a) Clear spacing between bars: not less than the greater of $1\frac{1}{2}$ inches, $1\frac{1}{2}$ bar diameters, and $1\frac{1}{2}$ times the maximum aggregate size.
 - 3) Average spacing for 10 bars: $+\frac{1}{16}$ inch.
 - a) Do not use tolerance to decrease number of bars or increase bar spacing.

- b. Members 10 to 20 inches in thickness
 - 1) Cover: $\pm\frac{1}{4}$ inch.
 - 2) Longitudinal spacing for individual bars, stirrups, or ties: ± 1 inch.
 - a) Clear spacing between bars: not less than the greater of $1\frac{1}{2}$ inches, $1\frac{1}{2}$ bar diameters, and $1\frac{1}{2}$ times the maximum aggregate size.
 - 3) Average spacing for 10 bars: $+\frac{1}{16}$ inch.
 - a) Do not use tolerance to decrease number of bars or increase bar spacing.
 - c. Members greater than 20 inches in thickness
 - 1) Cover: $-\frac{1}{4}$ inch, $+\frac{1}{2}$ inch.
 - 2) Spacing for stirrups or ties: ± 3 inches.
 - a) Clear spacing between bars: not less than the greater of $1\frac{1}{2}$ inches, $1\frac{1}{2}$ bar diameters, and $1\frac{1}{2}$ times the maximum aggregate size.
 - 3) Longitudinal bar spacing ± 3 inches.
 - a) Clear spacing between bars: not less than the greater of $1\frac{1}{2}$ inches, $1\frac{1}{2}$ bar diameters, and $1\frac{1}{2}$ times the maximum aggregate size.
 - 4) Average spacing for 20 bars: $+\frac{1}{4}$ inch.
 - a) Do not use tolerance to decrease number of bars or increase bar spacing.
 - d. Length of bar laps -1 inch
 - e. Embedment length -1 inch
- D. Tie bars together with ties at intersections except when spacing is less than 9 inches in each direction, in which case tie at alternate intersections.
 - 1. Tie bundled bars together at not more than 6 ft centers.
- E. Maintain the required distance from the forms and between layers of reinforcement with prefabricated chairs, ties, hangers, or other devices.
- F. Use precast concrete block bar supports only when the concrete is placed in contact with the soil and then only as the support for the bottom mat of bars.
- G. Do not tack weld reinforcing bars in place.
- H. Overlap at least one panel of welded wire reinforcement sheets to each other and fasten at the ends and edges.
- I. Support reinforcing steel for concrete "T" beams, pier caps, approach slabs, and deck slabs on metal chairs or bar supports according to this Section, Article 2.6.

- J. Space chairs for supporting the top steel and bolsters for supporting the bottom steel not more than 4 ft on center of the bar in each direction.
- K. Tie deck steel to beams or forms at regular intervals of not more than 5 ft on center along the beams to prevent steel movement during concrete placement.
- L. Support reinforcing steel for slabs on grade on metal chairs attached to a sand plate or use precast concrete block supports according to this Section, Article 2.6.
- M. Do not place concrete until the Engineer has verified the reinforcement placement and fastening.
- N. Place stainless steel reinforcement so that it does not come in contact with carbon steel.
 - 1. Do not tie stainless steel to uncoated or coated carbon steel reinforcement, galvanized attachments, or galvanized conduits.
 - a. Maintain at least 1 inch clearance between the metals using nylon or polyethylene spacers when stainless steel reinforcing or dowels must be near coated or uncoated reinforcing, or galvanized metals. Bind using nylon cable ties.
 - 1) Maintain at least 1 inch clearance unless insufficient space exists.
 - a) Either bar may be sleeved with a 1/8 inch minimum thick insulator material, such as polyethylene, nylon or rubber tube, extending at least 1 inch in either direction past the point of closest contact between the two dissimilar bars.
 - b) Sleeves are not allowed for bars that run parallel to each other.

3.3 FIELD CUTTING

- A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.
- B. Repair the coating at the sawed or sheared end using the specified patching or repair material.

3.4 SPLICING

- A. Furnish all reinforcing steel in the lengths shown.

- B. Do not splice bars except where shown.
- C. Stagger splices as far as possible.
- D. Place and tie lapped splices in the bars. Maintain the minimum distance to the surface of the concrete shown.
- E. Do not allow lap splices in vertical column reinforcing bars unless shown.
- F. Do not lap splice No. 14 and No. 18 bars.
 - 1. Use mechanical splice couplers.
- G. Use mechanical splice couplers when shown.
 - 1. Follow the manufacturer's published recommendations for equipment and splicing procedures.

3.5 FIELD BENDING

- A. Do not field bend reinforcing steel unless shown.
- B. Follow the authorized field bending procedures.
- C. Use methods that do not damage coatings.
- D. Do not heat the bars during the bending operations.
- E. Do not bend bars partially embedded in concrete except as shown or pre-approved by the Engineer. Do not field straighten or re-bend fabricated bent bars.

3.6 INSTALLATION OF DOWELLED ANCHORS

- A. Use dowelled anchors according to the following:
 - 1. Drill, brush, and clean all holes and install all doweled anchors according to manufacturer's published recommendations, applicable specifications, and as shown.
 - 2. Do not install dowelled anchors until the holes are verified by the Engineer.
 - 3. Install dowelled anchors. Test dowelled anchors to 90 percent of the dowelled anchor yield strength when shown, and as follows:
 - a. Allow anchor adhesives to cure 48 hours before testing.
 - b. Tension test according to ASTM E 1512.

3.7 CONNECTION PROCEDURE USING GROUTED SPLICE COUPLERS

- A. Use personnel familiar with installation and grouting of splice couplers and that have completed at least two successful projects in the last two years.
 - 1. Train new personnel within three months of installation by a manufacturer's technical representative as an acceptable substitution for the experience.
- B. Remove and clean all debris from the joints before grout application.
- C. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, or any contaminants other than water.
- D. Embed rebar anchor dowels to the minimum coupler embedment required by the manufacturer.
- E. Saturate Surface Dry (SSD) all joint surfaces before connecting the elements.
- F. Use shims to verify that the reinforcing extensions are within the manufacturers recommended tolerance.
- G. Maintain a minimum grout and sleeve temperature of 50 degrees F. Monitor the temperature of the covered grouted splice couplers until the temporary bracing is removed.
- H. Conform to the manufacturer's instructions for grout mixing, water to grout ratio, mixing time, and shelf life.
- I. Mix structural grout and coupler grout just before use according to the manufacturer's instructions.
- J. Follow the manufacturer's recommendations for coupler installation and grouting.
- K. Monitor the grouting operation to verify that all sleeves have been filled.
- L. Verify that all sleeves are protected from any vibration, shock, or other excessive movement until temporary bracing is removed.
- M. Conform to the following when installing couplers above a horizontal joint:
 - 1. Determine the thickness of shims to provide the specified elevation within tolerance.
 - 2. Follow non-shrink grout manufacturer's recommendations for mixing, joint surface preparation, and application.

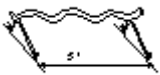
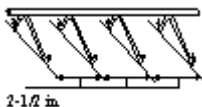
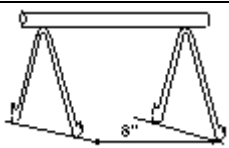
3. Place non-shrink grout on the interface between the two elements being joined before setting the element.
 - a. Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.
 - b. Prevent the grout from entering the coupler above elements by using grout dams or seals.
 4. Set the element in place.
 - a. Engage all couplers in the joint.
 - b. Allow the grout to seep out of the joint.
 5. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
 - a. Pack grout into any voids around the joint perimeter.
 6. Flush out the coupler with clean potable water.
 7. Mix the special coupler grout according to the manufacturer's recommendations for methods and proportions of mix and water.
 8. Make four sets of three 2 inch cube specimens for testing.
 - a. Cure the specimens according to AASHTO T 106.
 - b. Test one set of cubes for compressive strength to determine when to release bracing. Refer to this Section, Article 1.5 paragraph B4a2.
 - c. Test one set of cubes at 28 days for acceptance.
 - d. Store extra sets for longer term testing if necessary.
 - e. Use a Department qualified laboratory to take the samples and perform the tests.
 9. Pump the coupler grout into the coupler that is cast into the element.
 - a. Start from the lower port.
 - b. Pump until the grout is flowing freely from the upper port.
 - c. Cap the upper port first and then remove the nozzle to cap the lower port.
 10. Cure the joint according to the grout manufacturer's recommendations.
- N. Conform to the following when installing couplers below a horizontal joint:
1. Determine shim thickness to provide the specified elevation within tolerance.
 2. Before setting the element:
 - a. Mix the coupler grout paying strict attention to the manufacturer's recommendations for methods and proportions of mix and water.
 - b. Clean debris from the interior using compressed air.
 - 1) Remove any rain water using a vacuum that can remove water from the confined space in the coupler.
 - c. Place the coupler grout into the coupler by pouring or pumping.

- d. Place grout on the interface between the two elements being joined.
 - 1) Crown the thickness of the grout toward the center of the joint so that the grout can be displaced outward as the element is lowered onto the joint.
 - 3. Trowel off excess grout to form a neat joint once the element is set, plumbed, and aligned.
 - a. Pack grout into any voids around the joint perimeter.
 - O. Conform to the following when installing couplers in vertical joints (horizontal bar/coupler connection):
 - 1. Establish a method to provide the specified elevations, alignment, and spacing within tolerance.
 - 2. Use washers or seals to prevent mixing the joint grout and the coupler grout.
 - 3. Apply epoxy adhesive to the interface between the two elements being joined.
 - 4. Set the element in place.
 - a. Engage all couplers in the joint.
 - 5. Flush out the couplers with clean potable water once the element is set, plumbed, and aligned.
 - 6. Mix the coupler grout paying strict attention to the manufacturer's recommendations for methods and proportions of mix and water.
 - 7. Pump the coupler grout into the coupler that is cast into the element.
 - a. Start from the port closest to the joint.
 - b. Pump until the grout is flowing freely from the other port.
 - c. Cap the port farthest from the joint first and then remove the nozzle to cap the other port.
 - 8. Form the edges of the joint and place grout into the joint.
 - 9. Cure the joint according to the grout manufacturer's recommendations.

3.8 FIELD QUALITY CONTROL

- A. Inspect coated bars for damage to the coating after the bars are in place and immediately before concrete placement.

Table 1

Bar Supports							
Types and Sizes				Minimum Wire Sizes ² and Geometry			
Symbol	Bar Support Illustration	Type of Support	Standard Sizes	Nominal Height	Carbon Steel		Geometry
					Top	Legs	
SB ¹		Slab Bolster	¾, 1, 1½, and 2 inch heights in 5 ft and 10 ft lengths	All	4 ga. Corrugated	6 ga.	Legs Spaced 5 inches on Center, Vertical Corrugations Spaced 1 inch on Center (See Note 3)
BB ¹		Beam Bolster	1, 1½, and 2 inch; over 2 inch to 5 inch heights in increments of ¼ inch lengths of 5 ft.	Up to 1½ inch incl.	7 ga.	7 ga.	Legs Spaced 2½ inches on Center (See Note 3)
				Over 1½ inch to 2 inches incl.	7 ga.	7 ga.	
				Over 2 inches to 3½ inches incl.	4 ga.	4 ga.	
				Over 3½ inch	4 ga.	4 ga.	
BC		Individual Bar Chair	¾, 1, 1½, and 1¾ inch heights	All	-----	7 ga.	(See Note 3)
JC		Joist Chair	4, 5, and 6 inch widths and ¾, 1, and 1½ inch heights	All	-----	6 ga.	(See Note 3)
HC or HPC*	 * SAND PLATE NEED NOT BE COATED	Individual High Chair	2 inch to 15 inch heights in increments of ¼ inch.	2 inches to 3½ inches incl.	-----	4 ga.	Legs at 20 degree or less with vertical. When height exceeds 12 inches, legs are reinforced with welded crosswires or encircling wires (See Note 4)
				Over 3½ inches to 5 inches incl.	-----	4 ga.	
				Over 5 inches to 9 inches incl.	-----	2 ga.	
				Over 9 inches to 15 inches incl.	-----	0 ga.	
CHC		Continuous High Chair	Same as HC in 5 ft and 10 ft lengths	2 inches to 3½ inches incl.	2 ga.	4 ga.	Legs at 20 degree or less with vertical. All legs 8¼ inches on center maximum, with leg within 4 inches of end of chair, and spread between legs not less than 50 percent of nominal height. (See Note 5)
				Over 3½ inches to 5 inches incl.	2 ga.	4 ga.	
				Over 5 inches to 9 inches incl.	2 ga.	2 ga.	
				Over 9 inches to 15 inches incl.	2 ga.	0 ga.	

Notes and Bar Supports Table, see next page.

Notes:

1. Provide top wire on continuous supports, not otherwise designated as corrugated, which may be straight or corrugated at the option of the manufacturer.
2. Provide minimum wire sizes that are American steel and wire gauges.
3. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 70 percent of the nominal height.
4. Provide adequate stability against overturning. The leg spread measured between points of support on the minor axis must be at least 55 percent of the nominal height.
5. Provide adequate stability against overturning and adequate load capacity. The leg spread measured between points of support on the minor axis must not exceed the minimum and maximum percentages of the nominal height as shown.

Table 2

Support Axis		
Nominal Height (inches)	Distance Between Supports as a Percent of Nominal Height	
	Minimum	Maximum
Under 4	70	No Limit
4	70	95
6	65	90
8	60	85
10	55	80
12	50	75
Over 12	50	75

END OF SECTION

SECTION 03251

POST-TENSIONING CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Post-tensioning (PT) system and grouting of prestressing steel for concrete elements.
- B. Items necessary for the particular prestressing PT system used, including but not limited to ducts, anchorage assemblies, supplementary reinforcing bars, and grout used for pressure grouting ducts.

1.2 RELATED SECTIONS

- A. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

- A. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement
- B. AASHTO M 204: Uncoated, Stress-Relieved Steel Wire for Prestressed Concrete
- C. AASHTO M 275: Uncoated High-Strength Steel Bars for Prestressed Concrete
- D. AASHTO LRFD Bridge Construction Specifications, current edition
- E. AASHTO LRFD Bridge Design Specifications, current edition
- F. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- G. ASTM A 240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications
- H. ASTM A 653: Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- I. ASTM C 307: Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing

- J. ASTM C 531: Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- K. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- L. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete
- M. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear
- N. ASTM C 1583: Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-Off Method)
- O. ASTM D 3035: Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- P. ASTM D 3350: Polyethylene Plastics Pipe and Fittings Materials
- Q. ASTM D 3895: Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
- R. ASTM D 4285: Indicating Oil or Water in Compressed Air
- S. ASTM D 5989: Extruded and Monomer Cast Shapes Made From Nylon (PA)
- T. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs
- U. ASTM F 714: Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- V. ASTM F 2136: Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe
- W. MIL-PRF-3420: Wrapping Materials, Volatile Corrosion Inhibitor Treated, Opaque
- X. PTI M50.3: Post-Tensioning Institute (PTI) Guide Specification for Grouted Post-Tensioning

- Y. PTI M55.1: Post-Tensioning Institute (PTI) Specification for Grouting of Post-Tensioned Structures

1.4 DEFINITIONS

- A. Inlet and outlet pipes – The terms inlet pipes and outlet pipes are synonymous with vents, drains, injection, ejection, or inlet/outlet ports. Inlet and outlet pipes are devices connected to the PT system used for the injection of materials into or the ejection of materials from inside the ducts.
- B. Jacking force – The force applied to the tendon before anchorage and the occurrence of losses, including the anchor set loss.
- C. Permanent force – The force remaining in the prestressing steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in prestressing steel due to sequence of stressing, friction, unintended wobble of ducts, anchor set, friction in anchorages, and all other losses particular to the method or system of prestressing have taken place or have been provided for.
- D. Torpedo – A rigid object sized to fit through undamaged post-tensioning ducts. Used to prove that installed ducts have not been blocked or damaged during the concrete pour.

1.5 SUBMITTALS

- A. Working Drawings
1. Detailed drawings of the PT system for review. Include at least the following:
 - a. Anchorage and bearing details including local zone and grillage reinforcement
 - b. Duct placement including individual tendon center of gravity (CG) locations and combined tendon CG location at anchorages, low points, and high points
 - 1) Not required for segmental bridges or precast deck panels
 - 2) Distribute the prestressing force in cast-in-place post-tensioned bridge girders with approximately equal quantity in each girder and place the force symmetrically about the centerline of the structure
 - c. Method and spacing of duct supports
 - d. Duct ties and stirrup ties
 - e. Inlet and outlet pipe locations
 - f. Expected friction coefficient, wobble coefficient, and anchor set
 - g. Jacking forces, jacking ends, initial stresses, and sequence

- h. Permanent grout cap detail
 - i. Material data sheets for tendons, ducts, and permanent grout cap
 - j. Calculated elongations and tolerances
 - k. Bar couplers when shown
 - l. High point outlet inspection details
 - m. Anchorage inspection details
 - 2. Include supporting engineering calculations.
 - a. Design the post-tensioning system according to AASHTO LRFD Bridge Design Specifications
 - b. Include computations and a typical tendon force diagram after friction and anchor set losses based upon expected actual coefficients and values for the PT system to be used.
 - 3. Provide detailed congestion drawings integrating PT system and concrete reinforcing at locations where duct or anchorage passes through grids of reinforcing steel, such as at anchorage zones, diaphragms, bents, and other highly congested areas.
 - a. Indicate additions or rearrangement of reinforcing steel and revisions to concrete dimensions from that shown.
- B. Personnel Qualifications
 - 1. Provide names and current certifications of qualified supervisors for approval.
 - a. Refer to this Section, article 1.6
- C. Grouting Procedures and Safety Procedures
 - 1. Submit grouting procedures at least 45 calendar days in advance of scheduled grouting operations for review.
 - a. Include the following:
 - 1) Names, proof of training and experience records for the grouting crew and the crew supervisor in conformance with this Specification
 - 2) Type, quantity, brand, and certifications for materials used in grouting, include product data sheets
 - 3) Equipment data, including capacity in relation to demand, as well as provisions for back-up equipment
 - 4) General grouting procedure
 - 5) Duct cleaning procedure
 - 6) Duct pressure test and repair procedure.
 - 7) Mixing and pumping procedure
 - 8) Method to be used to control the rate of flow within ducts
 - 9) Theoretical grout volume calculations
 - 10) Direction of grouting and sequence of inlet and outlet pipe usage

- 11) Procedures for handling blockages and potential regrouting and post grouting repair.
 2. Submit safety procedures for information.
- D. Prestressing Steel
1. Accompany each lot of prestressing steel with a mill certificate and a test report including the following:
 - a. Chemical composition (not required for strand)
 - b. Cross-sectional area
 - c. Yield and ultimate strengths
 - d. Elongation at rupture
 - e. Modulus of elasticity
 - f. Stress strain curve for the actual prestressing steel intended for use
 2. Supply a certificate of conformance stating the manufacturer's minimum guaranteed ultimate tensile strengths and actual ultimate strengths with each reel or heat of prestressing steel wires, bars, or strands. Refer to this Section, Article 2.2.
 3. Samples for prestressing steel testing
 - a. Provide samples to the Department for verification testing from each manufactured reel of prestressing steel strand, from each size and each heat of prestressing bars, from each coil of prestressing wire, and from each lot of anchorage assemblies and bar couplers to be used.
 - 1) Provide three 5 ft long samples of each size from each reel for strand.
 - 2) Provide three 7 ft long samples from each heat or reel for wire or bars.
- E. Post-Tensioning Anchorages
1. Submit a test report and certificate of conformance provided by an independent testing laboratory for review which indicates that the anchorages meet the testing requirements in Section 10.3.2.3 of the AASHTO LRFD Bridge Construction Specifications.
 - a. Indicate that anchorages satisfy the requirements stated in this Section, Article 2.3, paragraph A.
- F. Stressing Jacks
1. Refer to this Section, Article 3.4, paragraph B.
 2. Furnish calibration charts certified by an independent laboratory with each jack and associated gauge or load cell used on the project.
 - a. Calibrate jack and its gauge or load cell as a unit with the cylinder extension in the approximate position that it will be at final jacking force.

- b. Provide certification for accuracy of the jack and associated gauge or load cell at the start of the work, after repair or adjustment, and every 180 days thereafter or as requested by the Department.
 - c. Provide pressure gauge calibration charts that are done while the jack is in the identical configuration as will be used on site including same length of hydraulic lines.
- G. Duct Pressure Field Test Records
 - 1. Submit a copy of the duct pressure field test records specified in this Section, Article 3.3, paragraph B for information.
- H. Elongation Records Record elongations of each tendon at time of stressing along with jacking force and target elongation. Refer to this Section, Article 3.4.
 - 1. Submit record of elongation of each tendon at time of stressing along with jacking force, gauge pressure, and target elongation for information within five days of completed tendon installation. Refer to this Section, Article 3.4, paragraph D.
- I. Stressing Operation Records
 - 1. Submit a copy of the stressing operation records specified in this Section, Article 3.4, paragraph A5 for information.
- J. Post-Tensioning Grout Test Reports
 - 1. Submit certified test reports for review from an independent Laboratory, Cement Concrete Reference Laboratory (CCRL) approved, which show that the post-tensioning grout material meets the requirements specified in this Section, Article 2.6.
- K. Grouting Operation Reports
 - 1. Submit for information:
 - a. Progress of grouting operations for each duct signed by grouting operation supervisor in control of the work for information within five calendar days after grouting
 - b. Information per duct indicating dates of tendon installation and grouting
 - c. Copy of the grouting operation records specified in this Section, Article 3.5, paragraph E11

1.6 SUPERVISOR REQUIREMENTS

- A. PT system manufacturer's representative must:
 - 1. Be certified as a PTI Level 2 Bonded PT Field Specialist
 - 2. Attend the preconstruction meeting

3. Be present at all times during installation of PT system components to:
 - a. Inspect and approve installation of hardware, including ducts
 - b. Provide instructions to the Contractor regarding concrete placement around the ducts, end-anchorage assemblies, and other appurtenances
 4. Provide close observation and control of:
 - a. Duct pressure field test
 - b. Stressing and anchoring of tendons
 - c. Post-grout inspections and repairs
 - d. Record keeping, certification of stressing results, and approval of elongations
 5. Be present for grouting operations
 6. Review and sign:
 - a. Duct pressure field tests records
 - b. Elongation records
 - c. Stressing operation records
 7. More than one representative is required when multiple PT operations are occurring simultaneously.
- B. Grouting operation supervisor must:
1. Be certified as either an ASBI Certified Grouting Technician or a PTI Level 2 Bonded PT Field Specialist
 2. Attend the preconstruction meeting
 3. Provide close observation and control of grouting operations, including:
 - a. Mixing and placing
 - b. Field trial tests
 - c. Field mockup tests
 - d. Production tests
 4. Review and sign:
 - a. Grouting Procedures
 - b. Safety Procedures
 - c. Grouting operation reports

PART 2 PRODUCTS

2.1 GENERAL

- A. Store materials in a weatherproof building, shed, covering, or container until time of use.
- B. Equipment for oil-free and water-free compressed air.
 1. Refer to ASTM D 4285.

2.2 PRESTRESSING STEEL

- A. Materials:
 - 1. Strand
 - a. Uncoated, Grade 270, low-relaxation, 7-wire strand conforming to AASHTO M 203
 - 2. Bar
 - a. Uncoated deformed (Type II) conforming to AASHTO M 275
 - 3. Wire
 - a. Uncoated, low-relaxation conforming to AASHTO M 204
- B. Attach tags for strand from each manufactured reel, bars of each size from each mill heat, wire from each coil, anchorage assemblies, PT system components and bar couplers to be shipped to the site.
 - 1. Assign the individual lot number and tag in such a manner that each lot can be accurately identified at the job site.
 - 2. Unidentified prestressing steel, anchorage assemblies, or bar couplers received at the site will be rejected if there is a loss of positive identification of these items at any time.
- C. Use bar couplers only at the locations shown.
 - 1. Use mechanical couplers that develop at least 96 percent of the actual ultimate strength of the bar, tested in an unbonded state, without exceeding anticipated set.
 - 2. Use couplers for bars that do not reduce the elongation at rupture below the anticipated elongation of an uncoupled bar.
- D. Protect prestressing steel against physical damage and rust or other results of corrosion at all times from manufacture to grouting or encasing in concrete.
 - 1. Do not use prestressing steel that has sustained physical damage.
 - 2. Remove and discard lengths of strand containing broken wire.
 - 3. Use wire that is bright and uniformly colored, having no foreign matter or pitting on its surface.
 - 4. Package prestressing steel in containers or shipping forms to protect the steel against physical damage and corrosion during shipping and storage.
 - a. Use a corrosion inhibitor which prevents rust or other results of corrosion, placed in the package or form,
 - 1) Use a corrosion inhibitor either placed in the package form, or applied directly to the steel that has no deleterious effect on the steel, grout, concrete or bond strength of steel to grout.
 - 2) Use inhibitor carrier type packaging material that conforms to the provisions of Federal Specification MIL-PRF-3420.

- b. Immediately rejuvenate or replace the corrosion inhibitor if its useful life expires.
- 5. Use shipping package or form that is clearly marked with a statement that the package contains high-strength prestressing steel, care to be used in handling, the type, kind, and amount of corrosion inhibitor used including the date when placed, safety orders, and instructions for use.
 - a. Immediately replace damaged packaging or forms or restore to original condition.

2.3 POST-TENSIONING ANCHORAGES

- A. Use anchoring devices that develop at least 96 percent of the actual ultimate tensile strength of the prestressing steel, tested in an unbonded state, without exceeding the anticipated set.

2.4 DUCTS

- A. General
 - 1. Use corrugated galvanized metal ducts, corrugated plastic ducts, rigid steel pipe ducts or smooth plastic ducts.
 - a. Use ducts that are mortar tight, and capable of withstanding concrete pressures without deforming or permitting the entrance of cement paste during the placing of concrete.
 - b. Use ducts that can be accurately bent and placed at the locations shown.
 - 2. Minimum internal dimensions for:
 - a. Multi-strand tendons: cross-sectional area $2\frac{1}{2}$ times the cross-sectional area of the prestressing steel
 - b. Prestressing bars: diameter $\frac{1}{2}$ inches larger than bar outside diameter, measured across deformations
 - c. Prestressing bars with couplers: diameter $\frac{1}{2}$ inches larger than largest dimension of the largest enclosed element
 - 1) Enclose bar couplers and coupler components in housings long enough to permit the necessary movements
 - 3. Use ducts that have properties compatible with the assumed design values shown.
 - 4. Use ducts that can be bent as shown without crimping or flattening and have sufficient strength to maintain their correct alignment during placing of concrete.
 - 5. Use duct splices at joints between precast segments that are capable of positively preventing the entrance of cement paste and water from concrete.
 - a. Use duct splices that do not cause electrolytic action or deteriorate.

6. Provide reference marks on rigid ducts to facilitate orientation during placement.
 7. Provide hold down ties to the forms when the buoyancy of the ducts in the fluid concrete would lift the reinforcing steel.
- B. Metal Ducts:
1. Fabricate corrugated semi-rigid ducts from ASTM A 653 galvanized sheet steel, coating designation G90.
 - a. Use a minimum wall thickness of:
 - 1) 26 gauge for semi-rigid ducts less than or equal to 2.625 inches in diameter
 - 2) 24 gauge for semi-rigid ducts greater than 2.625 inches in diameter
 - 3) 31 gauge when bar tendons are preassembled with semi-rigid ducts
 - b. Fabricate with either welded or interlocked seams.
 - 1) Galvanize welded seams.
 2. Fabricate rigid steel pipe ducts from galvanized ASTM A 53 Grade B schedule 40 steel pipe.
 - a. Use pipe with smooth inner walls capable of being curved to the proper configuration without crimping or flattening.
 3. Provide joints between sections of ducts that have positive metallic connections which do not result in angle changes at the joints.
- C. Plastic Ducts
1. Refer to Section 10.8.3 of the AASHTO LRFD Bridge Construction Specifications for the fabrication and testing requirements of corrugated plastic ducts.
 - a. Use seamless fabrication methods to manufacture corrugated plastic duct.
 2. Use rigid smooth black polyethylene ducts manufactured from 100 percent virgin polyethylene resin meeting the requirements of ASTM D 3350 with a minimum cell class of 445574C where the tendon is not embedded in concrete.
 - a. Use a resin containing antioxidant(s) with a minimum oxidation induction time (OIT) according to ASTM D 3895 of not less than 40 minutes.
 - b. Manufacture smooth duct with a dimensional ratio (D/R) of 17.0 as established by either ASTM D 3035 or ASTM F 714 as appropriate for the manufacturing process used.
 - c. Use duct meeting the minimum pressure rating of 100 psi.

- D. Exceptions
1. Use plastic ducts that are leak tight, vapor tight and impermeable where special corrosion protection is required, such as in bridge decks, external tendons, and bridge elements subjected to corrosive environments.
 2. Use plastic ducts where stray electrical currents may cause corrosion damage to tendon materials.
 3. Do not use plastic ducts when the radius of curvature of the tendon is less than 30 ft.
- E. Splices, Joints, Couplings, Connections, and Inlet and Outlet Pipes
1. Use stainless steel, nylon, or polyolefin materials.
 - a. Stainless steel products other than bolts, conform to ASTM A 240 Type 316.
 - 1) ASTM F593 Type 316 for bolts
 - b. Nylon products, use one of the following cell classes according to ASTM D 5989:
 - 1) S-PA0141 (weather resistant)
 - 2) S-PA-0231 (heat stabilized)
 - 3) S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizers added)
 - c. Polyolefin products, conform to the following:
 - 1) Contains antioxidants with a minimum induction time of 20 minutes according to ASTM D 3895
 - 2) Remolded finished polyolefin material has a stress crack resistance minimum failure time of 3 hours at an applied stress of 348 psi using ASTM F 2136
 2. Make splices, joints, couplings, and connection to duct and anchorage with devices or methods (mechanical couplers, plastic sleeves, heat-shrink sleeves) producing a smooth interior alignment with no lips or kinks.
 - a. Provide connections and fittings that are airtight and watertight.
 - b. Tape sealed connections or repairs are not permitted
 - c. Heat-shrink sleeves requirements, refer to PTI M50.3, Section 4.3.7.
 - d. Provide connections that are external to the concrete with a minimum pressure rating of 100 psi.
 3. Plastic components, including fasteners, must be free of water soluble chlorides and not react with the concrete or enhance corrosion of the prestressing steel.

4. Use inlet and outlet pipes that are $\frac{3}{4}$ inch minimum inside diameter for strand tendons, or $\frac{3}{8}$ inch for single bar tendons.
 - a. Use inlet and outlet pipes that are fitted with positive mechanical shut-off valves or plugs.
 - 1) Design and test inlets, outlets, valves, and plugs to resist a minimum pressure of 150 psi.
 - b. Extend pipes a sufficient distance out of the concrete member to allow for proper closing of the valves

2.5 REINFORCING STEEL

- A. Use coated reinforcing steel according to Section 03211.

2.6 PT GROUT

- A. Use a commercial, prepackaged, anti-bleed, post-tensioning grout conforming to the requirements for a Class C grout as defined by PTI M55.1.
 1. Furnish grout capable of meeting the vertical rise requirements for the project tendons.
 2. Deliver grout in plastic lined or coated moisture proof containers, stamped with the application type, date of manufacture, lot number and mixing and pumping instructions.
 - a. Use grout within 6 months of manufacture.
 3. Use water that is potable, clean, and free of injurious quantities of substances known to be harmful to Portland cement or prestressing steel.

2.7 EPOXY GROUT

- A. Refer to Table 1 for properties

Table 1

Epoxy Grout Properties		
Property	Test Method	Requirements
Compressive Strength (7 day)	ASTM C 579 Method B, 2 inch cubes, Load Rate II	> 10,000 psi
Tensile Strength (7 day)	ASTM C 307	> 2,000 psi
Slant Shear Bond Strength	ASTM C 882	> 1,500 psi
Linear Shrinkage	ASTM C 531	0.025%

2.8 PERMANENT GROUT CAP

- A. Use permanent grout caps made of one of the following:
 - 1. Fiber reinforced polymers using nylon, Acrylonitrile Butadiene Styrene (ABS), or polyester resins:
 - a. Use one of the following cell classes for products made from nylon:
 - 1) S-PA0401 (weather resistant)
 - 2) S-PA0231
 - 3) S-PA0401 (ultimate strength not less than 10,000 psi with ultraviolet stabilizer added) according to ASTM D 5989
 - 2. ASTM A 240 Type 316L stainless steel
- B. Use caps rated for a minimum pressure of 150 psi.
- C. Seal caps against the anchor bearing plate with neoprene “O”-ring seals and ASTM F 593 Type 316 stainless steel bolts.
- D. Provide an inlet port at the top of the cap or front of cap as appropriate.

2.9 EPOXY COMPOUND

- A. Comply with ASTM C 881 Type IV.

PART 3 EXECUTION

3.1 ANCHORAGE INSTALLATION

- A. Arrange the anchorage so that the prestressing force in the tendon can be verified before removal of the stressing equipment.
- B. Set anchorage devices or block-out templates for anchorages in a plane normal to the axis of the tendons so that anchor plates are normal in all directions of the tendon and bear uniformly on the concrete.
- C. Recess the anchoring devices so that the ends of the prestressing steel and parts of anchoring devices including permanent grout caps are embedded at least 2 inches inside the end surface of the element.
- D. Locate anchorages within plus or minus $\frac{1}{4}$ inch of the desired position laterally and plus or minus 1 inch along the tendon.
 - 1. Maintain minimum cover requirements.

- E. Verify entrance and exit angles of tendon paths at anchorages and at faces of concrete so they are within plus or minus 3 degrees of desired angle measured in any direction, and deviations in the alignment are accomplished with smooth transitions without kinks.

3.2 DUCT INSTALLATION

- A. Securely tie ducts in position, inspect, and repair before concrete placement is started.
 - 1. Use supplementary support bars where needed to maintain proper alignment of the duct.
- B. Securely fasten internal ducts to avoid displacing or damaging the ducts during concrete placement.
 - 1. Support polyethylene duct and metal duct for longitudinal PT in the flanges at intervals not to exceed 2 ft.
 - 2. Tie polyethylene duct in webs for longitudinal PT to stirrups at intervals not to exceed 2ft.
 - 3. Support flat ducts for transverse PT at intervals of not more than 12 inches.
 - 4. Tie metal duct for longitudinal PT in webs to stirrups at intervals not to exceed 4 ft.
- C. Verify final position of PT duct is within the tolerances shown in Table 10.4.1.1-1 of the AASHTO LRFD Construction Specifications.
 - 1. Position the duct as shown and adjust the reinforcement as determined by the Engineer if conflicts exist between the reinforcement and post-tensioning duct.
- D. Provide inlet/outlet ports at the following locations:
 - 1. Anchorage areas of tendon
 - 2. The high points of the duct, when there is more than a 20 inch variation in the vertical position of the duct
 - a. Locate additional outlet ports 3 ft to either side of the high point
 - 3. Low points of the duct. Verify outlet port is free draining
 - 4. Major changes in the cross section of the duct, such as coupler locations
 - 5. Locations as shown
- E. Verify that ducts, anchorage blockouts, openings, inlets, and outlets are kept clean and free of debris, fuel, oils, other contaminants, and site trash.
 - 1. Seal the ends of ducts after installation in the forms.
 - 2. Leave low point outlets open.

- F. Verify angle changes at duct joints are within plus or minus 3 degrees of desired angle measured in any direction, and deviations in the alignment are accomplished with smooth transitions without kinks.
- G. Use mandrels as stiffeners in each duct during concrete placement for precast segments.
 - 1. Extend mandrel throughout the length of the segment being cast and at least 2 ft into the corresponding duct of the previously cast segment.
 - 2. Provide mandrels of sufficient rigidity to maintain the duct geometry with the tolerances shown in this Section.

3.3 TENDON INSTALLATION

- A. Verify that ducts are unobstructed, undamaged, and free of water and debris after completion of concrete placement and before installing the prestressing steel.
 - 1. Prove that the ducts are clear of obstructions or damage by passing a suitably sized torpedo through the ducts.
 - a. Size the torpedo $\frac{1}{4}$ inch smaller than the clear, inside dimensions of the duct, with rounded ends.
 - b. Use a 2 ft long torpedo for straight ducts.
 - c. Size the torpedo, for sharply curved ducts, such that when both ends touch the outermost wall, the torpedo is at least $\frac{1}{4}$ inch clear of the inside wall.
 - d. The member will be rejected if the torpedo will not easily travel completely through the duct.
 - e. Using a torpedo to verify that ducts are clear is not required for four strand tendons in flat ducts used for transverse PT of segmental box-girders placed before concrete casting.
 - 1) Prove PT ducts are free and clear of obstructions or damage by moving the group of strands back and forth in duct for a minimum distance of 1 ft in each direction.
 - 2) Move strands easily, by hand, without resorting to excessive effort or mechanical assistance.
 - 2. Flush ducts with oil-free and water-free compressed air or water as required to remove unwanted material from inside of ducts.
 - a. Ducts subjected to contamination with chlorides, water used for flushing ducts may contain slack lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.1 lb/gal.
 - 1) Test for presence of chlorides and oils in discharged water before placing tendons.
 - 2) Continue to flush if chloride levels in flush water outflow exceeded 300 ppm until chloride level in flush water outflow is below 250 ppm.

- b. Blow all water out of the duct with oil-free compressed air and swab dry after flushing.
- B. Conduct duct pressure field tests before installing the internal or external prestressing steel.
 - 1. Install grout caps, inlet and outlet port caps, and other components necessary to seal ducts.
 - 2. Pressurize duct to 50 psi using oil-free and water-free compressed air.
 - a. Only one duct per web or girder may be tested at a time.
 - 3. Lock off the outside air source.
 - 4. Record pressure loss for 1 minute.
 - a. Locate the leak, repair, and retest if the pressure loss exceeds 15.0 psi for tendons greater than 150 ft long, or 25.0 psi for tendons less than or equal to 150 ft long.
 - 5. Include location and method of repair in duct air test records if repairs are required.
 - 6. Do not load strand until all pressure tests are successful.
- C. Strands in an individual tendon may be pushed or pulled through the duct individually, or may be pulled through the duct as a unit.
 - 1. Protect the strand which is being advanced into the duct from contact with abrasive materials such as steel or concrete and contaminants such as grease, oil, and dirt at all times.
 - a. Round off ends of strands and wires that are pushed, or fit advancing end with smooth protective cap.
 - b. Use pulling lines with a capacity of at least 2.5 times the dead weight of the tendons when used for essentially horizontal tendon installation.
 - c. Do not use pushing wheels made from metal.
 - d. Do not intentionally rotate strands or wires during installation.
 - e. Use a special steel wire sock or other device attached to advancing end if a tendon is pulled through the duct.
 - f. Do not install permanent tendons before completion of testing as required by this Section.

3.4 STRESSING TENDONS

- A. General
 - 1. Do not apply PT forces until the concrete has attained the required compressive strength as shown.
 - a. Do not apply PT forces to cast-in-place concrete structures other than segmentally constructed bridges until 10 days after the last concrete has been placed in the member.

- b. Make test cylinders for determining strength of the same concrete and cured under the same conditions as the member.
- 2. Stress all strands in each tendon simultaneously with a multi-strand jack except for those in flat ducts with not more than four strands.
- 3. Furnish equipment for tensioning the tendons from the manufacturer of the PT system.
- 4. Sequence the stressing of post-tension cast-in-place bridge such that no more than one tendon is stressed per web before stressing a tendon in another web.
 - a. Do not apply an eccentric force about the centerline of the structure that exceeds $\frac{1}{6}$ of the total post-tensioning force at any time during the prestressing.
- 5. Keep stressing operation records that include the following for each tendon installed:
 - a. Project Pin, Name, and number
 - b. Contractor and subcontractor
 - c. Tendon location, size and type
 - d. Date tendon was first installed in ducts
 - e. Coil and reel number for strands or wires and heat number for bars and wire
 - f. Assumed and actual cross-sectional area
 - g. Assumed and actual modulus of elasticity
 - h. Date stressed
 - i. Jack and gauge numbers per end of tendon
 - j. Required jacking force
 - k. Gauge pressures
 - l. Elongations (theoretical and actual)
 - m. Anchor sets (theoretical and actual)
 - n. Stressing sequence (for example tendons before and after this tendon)
 - o. Stressing mode (one end or two ends or simultaneous)
 - p. Witnesses to stressing operation (Contractor, manufacturer's representative, and Inspector)
 - q. Date grouted, days from stressing to grouting, grouting pressure applied, and injection end
 - r. Other relevant information

B. Stressing Jacks

- 1. Use hydraulic jacks to stress tendons that are capable of providing and sustaining the necessary forces. Equip each jack with either:
 - a. A pressure gauge with an accurately reading dial at least 6 inches in diameter.

- b. A load cell with indicator by means of which the prestressing force in the tendon may be determined.
 - 1) Do not use the lower 10 percent of the Manufacturer's rated capacity when determining the jacking stress.
 - 2. Use a jacking system that provides an independent means of measuring the tendon elongation.

C. Tensioning Operations

- 1. Tension prestressing steel so that the force of the prestressing steel will not be less than the value shown on the authorized shop drawings.
 - a. Do not exceed 80 percent of the guaranteed ultimate tensile strength of the prestressing steel during the stressing of the tendons.
 - 1) Replace tendons stressed past 80 percent of the guaranteed ultimate tensile strength.
 - b. Anchor the prestressing steel at initial stresses that will result in the long term retention of permanent forces of not less than those shown on the approved shop drawings.
 - c. Do not allow the initial stress at the anchorage to exceed 70 percent of guaranteed ultimate tensile strength after anchor set.
- 2. Remove and replace strand due to wire failure or slipping during stressing if any of the following conditions are met:
 - a. Member cross section has a final effective PT force less than 98 percent of the design total PT force based on the recorded jacking force or liftoff force, whichever is smaller.
 - b. PT force across a mating joint is less than 98 percent of PT force required by the contract drawings for that mating joint for that stage of construction.
 - 1) This requirement applies to segmental construction, or similar construction that has members post-tensioned together across a common joint face at any stage of construction.
 - c. Any single tendon has more than a 5 percent reduction in cross-sectional area or post-tensioning steel due to wire failure.
- 3. Follow stressing sequence shown in authorized shop drawings.

D. Elongations

- 1. Conduct the tensioning process such that tension being applied and the elongation of the post-tensioning steel can be measured at all times.
- 2. Keep a permanent record of gauge pressures and tendon elongations for each tendon.
- 3. Measure elongations to the nearest $\frac{1}{16}$ inch.

4. Preload tendons to 20 percent of their final jacking force before beginning elongation readings to eliminate take-up in the tensioning system.
5. Mark each strand before final stressing to permit measurement of elongation and to verify that all anchor wedges set properly.
6. The measured elongation must agree within 7 percent of the theoretical elongation for the post-tensioned elements to verify the required tendon force, or the entire operation must be checked and the source of the error determined and remedied to the satisfaction of the Department before proceeding with the work.
 - a. Do not overstress the tendon to achieve the theoretical elongation.
 - b. Acceptance may be achieved by force verification lift-off tests demonstrating that the measured force is within minus 1 percent and plus 5 percent of the required force as shown if the measured elongations fall outside of the acceptable tolerance.
7. Do not cut off the stressing tails of the tendons until the elongations have been approved by the PT system manufacturer's representative. Within 4 hours of approval:
 - a. Cut prestressing steel using an abrasive saw or plasma torch to within $\frac{3}{4}$ inch to $1\frac{1}{2}$ inch from anchorage.
 - 1) Flame cutting of PT steel is not permitted.
 - b. Clean rust and other debris from metal surfaces which will be covered by the grout cap
 - c. Place grout cap, including a seal, over the wedge plate until the tendon is grouted.

E. Protection of Steel After Installation

1. Minor rust which may form on the surface of the prestressing steel within 10 calendar days after protective packaging has been opened will not be cause for rejection.
2. Prestressing steel installed, tensioned, and grouted within 10 calendar days will not require the use of corrosion inhibitor in the duct following installation of the prestressing steel.
 - a. Blow a vapor phase corrosion inhibitor powder conforming to MIL-PRF-3420 into ducts containing prestressing steel if prestressing steel is anticipated to be removed from protective packaging for 10 days or more before grouting.
3. Do not exceed 15 calendar days between removal of prestressing steel from protective packaging and grouting operations.
 - a. Failure to begin grouting operations will result in stoppage of work.

3.5 GROUTING

A. General

1. Begin grouting operations to fill the void space between the duct and the tendons as soon as possible after all the prestressing steel has been tensioned, anchored and approved by the PT system manufacturer's representative.
2. Flush the inside of the duct with water under pressure to remove all traces of the corrosion inhibitor used to protect the prestressing steel if a vapor phase corrosion inhibitor has been blown into ducts before grouting.
 - a. Continue flushing operations until the discharge water is free of traces of the corrosion inhibitor.
 - b. Blow all water out of the duct with oil-free compressed air and swab dry after flushing.
3. Eliminate vibration from all sources under the contractor's control within 300 ft of the member being grouted for the duration of the grouting procedure and 4 hours after completion.
4. Conduct a joint meeting of the Contractor, grouting crew and the Engineer before grouting operations begin.
 - a. Discuss the grouting operation plan, required testing, corrective procedures, and other relevant issues at the meeting.

B. Temperature

1. Keep PT grout below 90 degrees F during mixing or pumping.
 - a. Cool the mixing water if necessary.
2. Keep ducts free of water to avoid damage due to freezing in temperatures below 32 degrees F.
3. Keep accurate temperature records covering maximum and minimum air temperatures, and temperatures of the concrete adjacent to the ducts to be grouted when ambient temperature may be expected to fall below 40 degrees F.
4. Do not use any material in which frost or ice is present, and keep the ducts and equipment free of frost and ice.
5. Postpone grouting operations if frost is expected within 48 hours of start.
6. Maintain a temperature of at least 35 degrees in the grout in the ducts for the duration of the grouting and the longer of 72 hours after completion or until job-cured 2 inch cubes of PT grout reach a minimum compressive strength of 800 psi when low temperatures are expected and grouting cannot be postponed.

- C. Equipment
 - 1. Use equipment which meets the requirements in Section 10.11.3 of the AASHTO LRFD Bridge Construction Specifications.
 - 2. Provide flushing equipment with an independent power source on site, capable of developing a pressure of 250 psi and of sufficient capacity to flush out partially grouted ducts as required due to blockage or breakdown of equipment.
 - a. Do not exceed the allowable grouting pressures when flushing. Refer to this Section, article 3.5 E7.
- D. Mixing
 - 1. Mix PT grout according to the manufacturer's recommendations.
 - a. Continue mixing grout until a uniform, thoroughly blended grout is obtained, without excessive temperature increase.
 - 2. Agitate the grout continuously until it is pumped.
 - 3. Do not begin grouting operations until the field trial tests specified in PTI M55.1, Section 4.7.1 have been satisfactorily performed.
 - a. Do not add water to increase grout flowability that has been decreased by delayed use of the grout.
 - 4. Perform field mockup test specified in PTI M55.1, Section 4.7.2, when required by the Engineer.
 - 5. Do not exceed a water-cement ratio of 0.45.
- E. Grouting Operations
 - 1. Blow oil-free and water-free compressed air through the ducts checking all inlet and outlet pipes to verify they are capable of accepting injection of the PT grout immediately before grouting.
 - 2. Open all inlet and outlet ports before grouting starts.
 - 3. Obtain target flow rates as a function of mixer type used and ambient temperatures from the PT grout manufacturer.
 - a. Verify the grouting rate is slow enough to avoid air entrapment and segregation of the grout and verify complete filling of the duct.
 - 4. Maintain a continuous, one-way flow of PT grout in a generally uphill direction.
 - a. Inject PT grout from near the lowest end of tendons.
 - b. Grout each tendon in one operation.
 - c. Flush the grout out of the duct with water immediately when one-way flow of grout cannot be maintained or grouting is interrupted.
 - 5. Refer to PTI M55.1, Section 4.7.3 for production test requirements of production grout.
 - 6. Perform normal operations at approximately 75 psi.
 - 7. Do not exceed a pumping pressure at the tendon inlet of:
 - a. 145 psi for internal polyethylene ducts
 - b. 245 psi for internal circular steel ducts

- c. 145 psi for external HDPE pipe
- d. Close the inlet and inject the PT grout at the next outlet (which now becomes an inlet) which has just been, or is ready to be closed, as long as a one-way flow is maintained if the actual grouting pressure exceeds the maximum allowed.
 - 1) Fit the outlet that is to be used for injection with a positive shutoff.
 - 2) Do not inject grout into a succeeding outlet from which grout has not yet flowed.
- 8. Waste grout through the first outlet after the inlet pipe until residual water or entrapped air has been removed,
 - a. Cap or otherwise close outlet when the consistency of the ejected grout is the same as the injected grout.
 - b. Close following remaining outlets in the same manner, except at high points where the outlets a short distance downstream to the high point are closed before the high point outlet.
 - c. Discharge at least 2 gallons of grout through the final outlet pipe before sealing.
- 9. Provide a standpipe at the upper end of the duct for vertical or nearly vertical tendons.
 - a. Design the standpipe to collect and store bleed water and allow it to be removed from the grout.
 - b. Locate the standpipe so that the level of the grout can be brought to an elevation so that bleeding will not cause the level of the grout to drop below the highest point of the upper anchorage device.
 - c. Remove the standpipe after the grout has hardened.
- 10. Do not remove or open plugs, caps, or valves until the PT grout has set.
 - a. Remove ends of inlet/outlet pipes at least 2 inches below the concrete surface after the grout has set.
 - b. Fill the void with epoxy grout within 4 hours of inlet and outlet removal.
 - c. Remove all miscellaneous material used for sealing grout caps before carrying out further work to protect anchorages.
 - d. Permanently seal all outlet and inlet openings for external tendons.
- 11. Keep grouting operation records that include the following for each duct:
 - a. Names of personnel performing the grouting activity
 - b. Identification of tendon
 - c. Date grouted
 - d. Number of days from tendon installation to grouting
 - e. Quantities and types of material used

- f. The maximum pumping pressure at the inlet
 - g. Temperature measurements of air, water, prepackaged material, mixture grout, and concrete member in the duct
 - 1) Note if temperatures are within acceptable limits.
 - h. Summary of tests performed and the results, including post-grouting inspection
 - i. Volume of grout pumped and capacity of duct accounting for reduction for area of prestressing steel
 - 1) Include ratio of actual grout used to anticipated quantity of grout used.
 - j. Time from beginning grouting operation to sealing all inlet and outlet pipes
 - k. Discussions of problems encountered during grouting and steps taken to resolve them
- F. Post-Grouting Inspection
- 1. Randomly inspect 10 percent of the inlet and outlet pipes at anchorage and at high points for voids by drilling and inspecting with a borescope.
 - a. Inspect ducts between 24 and 72 hours after grouting.
 - b. Use drilling equipment that will automatically shut off when steel is encountered to prevent damaging the prestressing steel and anchorages.
 - c. All anchorages and high points will be inspected if a void exposing prestressing steel is found by random drilling.
 - d. Fill drilled holes not indicating voids with epoxy compound within 4 hours of completion of inspections.
 - 1) Use an injection tube to fill drilled hole from the base.
 - e. Use vacuum grouting to fill voids that expose prestressing steel.
 - 1) Perform vacuum grouting operations under the direct supervision of a crew foreman who has been trained and has experience in the use of vacuum grouting equipment and procedures.

3.6 PROTECTION OF END ANCHORAGE

- A. Protect PT strand, wire, and bar anchorages as soon as practical, but not to exceed 10 days after grouting is completed.
- B. Cap inlets and outlets with plastic or stainless steel threaded plugs.

- C. Construct anchorage pour-backs with epoxy grout according to manufacturer's recommendations.
 - 1. Mechanically clean and abrasive blast clean the surface of concrete in anchorage recesses until clean aggregate is exposed.
 - a) Flush surface with water and blow dry.
 - 2. Do not damage reinforcing steel coatings.
 - 3. Test substrate at pour-back locations using ASTM C 1583 and develop a minimum of 175 psi tension.
- D. Construct pour-backs using tight fitting forms that can be installed and held in place securely against the previously placed concrete.
 - 1. Fill recess with epoxy grout and finish flush.

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete construction in concrete structures such as bridges, culverts, and miscellaneous structures.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02317: Structural Excavation
- C. Section 02701: Pavement Smoothness
- D. Section 03055: Portland Cement Concrete
- E. Section 03056: Self-Consolidating Concrete - SCC
- F. Section 03057: Structural Concrete - Lightweight
- G. Section 03152: Concrete Joint Control
- H. Section 03211: Reinforcing Steel and Welded Wire
- I. Section 03390: Concrete Curing
- J. Section 07105: Waterproofing Membrane
- K. Section 07921: Sealing Existing Concrete Slope Protection Joints

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 235: Epoxy Resin Adhesives
- C. AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works)

- D. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- E. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Drawings for Temporary Works.
 - 2. Deck Overhang Bracing for review when shown and when screed rails are supported on forms. Refer to this Section, Article 3.1, paragraph C2.
 - a. Include supporting calculations.
 - b. Provide the seal of a Professional Engineer or Professional Structural Engineer licensed in the State of Utah on drawings and calculations.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Bridge Decks and Approach Slabs:
 - 1. Class AA(LS). Refer to Section 03055.
- B. Concrete Slope Protection:
 - 1. Class A(AE). Refer to Section 03055.
- C. Other Structural Elements:
 - 1. Class AA(AE), unless described otherwise. Refer to Section 03055
 - 2. Self-Consolidating Concrete – SCC. Refer to Section 03056.
- D. Use the following only where shown.
 - 1. Class AA(ES). Refer to Section 03055.
 - 2. Structural Concrete – Lightweight. Refer to Section 03057.
 - a. Use the concrete class shown.

2.2 REINFORCING STEEL AND WELDED WIRE

- A. Refer to Section 03211.

2.3 JOINT FILLER AND SEALANT

- A. Preformed Joint Filler – Refer to Section 03152.

- B. Silicone Joint Sealer – Refer to Section 03152.
- C. Self Leveling Silicone Joint Sealer – Refer to Section 03152.
- D. Joint Sealer (Structures) – Refer to Section 03152.

2.4 BACKER ROD

- A. Refer to Section 03152.
- B. Size the diameter of the backer rod to a minimum of $\frac{1}{4}$ inch larger than the groove in which it is placed.

2.5 WATERSTOPS

- A. Refer to Section 03152.

2.6 RIGID PLASTIC FOAM

- A. Preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less. Refer to ASTM C 578.

2.7 FORMS

- A. Plywood, wood, metal, glass, or a combination of these materials.
- B. Use mortar-tight concrete forms, true to the dimensions, lines, and grades of the structure and of sufficient rigidity to prevent objectional distortion of the formed concrete surface caused by pressure of the concrete and other loads incidental to the construction operations.
- C. Discontinue using a form or forming system that produces a concrete surface with excessive undulations until modifications have been made.
 - 1. Undulations are excessive if they exceed either $\frac{1}{8}$ inch over 10 feet or $\frac{1}{270}$ of the center-to-center distance between studs, joints, forms, fasteners, or wales.
- D. Countersink all bolt and rivet holes when using metal forms for exposed surfaces so that a plane smooth surface of the desired contour is obtained.
- E. Use lumber that is free of knotholes, loose knots, cracks, splits, warps, or other defects that affect the strength or appearance of the structure.
 - 1. Rough lumber may be used for forming surfaces if visible rough surfaces do not show on the final structure.

- F. Form exposed element surfaces of a concrete structure with the same forming material or with materials that produce a concrete surface that is uniform in texture, color, and appearance.
- G. Do not use stay-in-place metal deck forms unless otherwise specified.

2.8 MISCELLANEOUS STEEL ITEMS

- A. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

2.9 EPOXY ADHESIVE

- A. Refer to AASHTO M 235, Type II.

2.10 WATERPROOFING MEMBRANE

- A. Refer to Section 07105

PART 3 EXECUTION

3.1 PREPARATION

- A. Falsework
 - 1. Design and construct falsework according to the AASHTO LRFD Bridge Construction Specifications, Section 3 (Temporary Works).
 - a. Design falsework so that loads imposed on existing, new, or partially completed portions of structures due to construction operations do not exceed the load carrying capacity of the structure or portion of the structure.
 - b. Brace and tie girders to resist forces that would cause rotation or torsion in the girders from the placing of concrete for diaphragms or decks, or show girders to be adequate for those effects.
 - c. Do not weld falsework support brackets or braces to structural steel members or to reinforcing steel.
 - 2. Footing Construction
 - a. Build falsework on a solid footing that is safe against undermining, protected from softening, and capable of supporting imposed loads.
 - b. Demonstrate that the soil bearing values do not exceed the supporting capacity of the soil.
 - 1) Conduct load tests or have soils investigation conducted by a professional engineer licensed in the State of Utah.

- c. Use piling or drilled shafts to support falsework that cannot be founded on a solid footing.
 - d. Space, drive, and remove piles according to the authorized falsework drawings.
 - 3. Construction
 - a. Use materials able to sustain the stresses required by the falsework design.
 - b. Use suitable jacks or wedges to set the forms to the grade or camber required, and to prevent settling.
 - c. Produce a finished structure of the specified camber and built to the lines and grades indicated.
- B. Forms
 - 1. Clean the inside surfaces of dirt, mortar, and foreign material before concrete placement.
 - 2. Use form oil that permits the ready release of the forms and does not discolor the concrete.
 - 3. Do not place concrete in the forms until:
 - a. All work connected with form construction has been completed.
 - b. All embedded materials have been placed.
 - c. All dirt, chips, sawdust, water, and other foreign materials have been removed.
 - d. Inspection and approval have been obtained.
 - 4. Do not use stay-in-place deck forms unless otherwise specified.
- C. Footings, Box Culverts, and Headwalls
 - 1. Excavation and Backfill – Refer to Section 02317.
 - 2. The Engineer may direct written changes in dimensions or elevations necessary to secure a satisfactory foundation.
 - 3. Do not dewater by pumping during concrete placement or for 24 hours thereafter unless pumping is outside the enclosure.
 - 4. Do not use well points to dewater footing.
- D. Bridge Decks
 - 1. Reinforcing Steel
 - a. Pass the screed over the area with a screed face device to measure the cover before concrete placement.
 - b. Relocate and tie reinforcing steel that projects above the specified level before placing the concrete.
 - c. Adjust and support reinforcing steel that does not meet the placement tolerances defined in Section 03211 before placing the concrete.

2. Screeds
 - a. Firmly support screed rails for bridge deck slabs to prevent movement during concrete placement.
 - b. Support the machine rails on the bridge beams when using a finishing machine.
 - c. Do not place the machine rails on the forms unless the form supports have been strengthened to prevent deflection and the Engineer gives authorization.
- E. Miscellaneous Construction
 1. Drainage and Weep Holes
 - a. Construct drainage and weep holes at locations shown or as directed.
 - b. Place ports or vents for equalizing hydrostatic pressure below low water.
 - c. Use non-corrosive materials for weep hole forms.
 - d. Paint exposed surfaces of metal drains as shown.
 2. Anchor Bolts
 - a. Securely and accurately set anchor bolts in bent caps, abutments, or pedestals before the concrete is placed.
 - b. Use templates to maintain location and plumbness.

3.2 PLACE CONCRETE

- A. Do not place concrete without authorization from the Engineer.
- B. Do not deviate from the deck placing sequence shown without written authorization from the Engineer.
- C. The Engineer may postpone placement operations if the concrete cannot be protected during adverse weather.
- D. Handling concrete:
 1. Avoid segregation of the ingredients.
 2. Arrange chutes, troughs, or pipes used as aids in placing concrete so the concrete does not separate.
 3. Use metal or metal-lined chutes and troughs. Do not use aluminum.
 4. Equip chutes with baffle boards or a reversed section at the end of the outlet when placing on steep slopes.
 5. Extend open troughs and chutes down inside the forms or through holes left in the forms. Terminate the ends in vertical downspouts.
 6. Thoroughly flush all chutes, troughs, and pipes with water before and after each placement.

7. Do not allow the free fall of concrete to exceed 10 ft for thin walls (maximum 10 inch thickness) or 5 ft for other types of construction without the use of a tremie or a flexible metal spout.
 8. Use flexible metal spout sections composed of conical sections not more than 3 ft long, with the diameter of the outlet and the taper of the various sections so the concrete fills the outlet and retards concrete flow.
- E. Placing concrete:
1. Deposit concrete as close as possible to its final position without allowing it to flow laterally in the form.
 2. Spread fresh concrete in horizontal layers with thickness not greater than what can be compacted with vibrators.
 3. Do not use vibrators to flow concrete laterally.
 4. Limit placement interruptions to 45 minutes.
 5. Place and vibrate each layer before the preceding layer has taken initial set.
 6. Do not place concrete in flowing water.
- F. Consolidating concrete:
1. Use high frequency internal vibrators to consolidate all concrete for structures except concrete placed under water.
 2. Use enough vibrators to consolidate the fresh concrete to the desired degree within 15 minutes after it is deposited in the forms.
 3. Supply at least two vibrators for structures involving more than 25 yd³ of concrete.
 4. Do not attach vibrators to or against the forms or the reinforcing steel.
 5. Do not allow vibrators to penetrate layers of concrete that have taken initial set.
 6. Use spades or wedge-shaped tampers to secure a smooth and even texture of the exposed surface.

3.3 PLACE CONCRETE UNDER WATER

- A. Place and deposit concrete under water as shown.
- B. Seal the forms or cofferdams watertight.
- C. Do not pump water while placing concrete or disturb the concrete until it has set at least 24 hours or attained at least 50 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
- D. Regulate placing to keep surfaces approximately horizontal at all times.

- E. Place the concrete by beginning at one end of the form and progressing in a zig-zag movement from side to side across the length of the form.
- F. Place the concrete using a tremie or concrete pumping equipment.
- G. Placing concrete with a tremie:
 - 1. Use an 8 inch to 12 inch diameter steel tube tremie constructed with watertight connections, a hopper to receive concrete, and a device at the bottom to exclude water from entering the tube.
 - 2. Use support that permits the discharge end to move over the entire top work surface and permits the tremie to be rapidly lowered to stop or retard flow when necessary.
 - 3. Minimize the number of tremie location shifts for continuous placement.
 - 4. Keep the tremie tube full to the bottom of the hopper during placement.
 - 5. Slightly raise the tremie when a batch is dumped into the hopper but do not raise it out of the concrete at the bottom until the batch discharges to the bottom of the hopper.
 - a. Re-plug the end and refill the tube with concrete if the concrete seal around the tube is lost.

3.4 PUMP CONCRETE

- A. Use a prequalified concrete pumping contractor. Refer to UDOT Quality Management Plan 511 – Concrete Pumping.
 - 1. Replace pump that causes excessive or erratic loss of air entrainment.
 - 2. Use a pump that produces a continuous stream of concrete without air pockets.
 - 3. Do not add water to the concrete in the pump hopper.
- B. Do not allow pump vibrations to damage freshly placed concrete.
- C. Do not use concrete contaminated by priming or cleaning the pump.

3.5 LIMITATIONS

- A. Light the work site so all operations are plainly visible if mixing, placing, or finishing occurs after daylight hours.
- B. Keep all traffic off concrete bridges and culverts for 14 days after final concrete placement, until all concrete is fully cured, and until all concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

- C. Keep all traffic off bridge deck and approach slab closure pours for at least 7 days after final concrete placement, until all concrete is fully cured, and until all concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
 - 1. High-early strength concrete used in bridge deck and approach slab closure pours may be opened to traffic at least 3 days after final concrete placement and after concrete achieves 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.6 CONSTRUCTION JOINTS

- A. Make construction joints where shown.
- B. Obtain Engineer's authorization when additional construction joints are desired and meet the following requirements:
 - 1. Place and construct without impairing strength and appearance.
 - 2. Place in planes perpendicular to the principal lines of stress and at points of minimum shear.
 - 3. Make monolithic structures by extending the reinforcing across the joint.
 - 4. Avoid construction joints through paneled wing walls or large surfaces that are to be treated architecturally.
 - 5. Make a straight line joint across the face of the pour for the full width of the bridge deck.
 - 6. Leave a rough surface to increase the bond with the concrete placed later.
 - 7. Form tapered sections with an insert so that the succeeding layer of concrete ends in a section at least 6 inches thick.
 - 8. Place a bulkhead from the surface to the top mat of steel to establish a straight vertical face. Shape the concrete below the top steel to a near vertical face in line with the bulkhead.
 - 9. Establish a straight vertical face by saw cutting to a minimum depth of 1 inch when a bulkhead cannot be placed.
 - a. Shape the concrete below the saw cut to a near vertical face.
- C. Meet the following before resuming concrete placement:
 - 1. Re-tighten forms.
 - 2. Roughen the surface of hardened concrete without leaving loosened particles or damaged concrete.
 - 3. Clean off concrete surface of foreign matter and laitance by sandblasting.
 - 4. Saturate concrete surface with water.
 - 5. Apply epoxy adhesive to face of construction joints.

3.7 CONCRETE SURFACE FINISHING CLASSIFICATIONS

- A. Ordinary Surface Finish – A true and uniform finished surface.
- B. Rubbed Finish – A surface smooth in texture and uniform in appearance free of form marks and irregularities.
- C. Wire Brush or Scrubbed Finish
 - 1. A finished surface with the cement surface film completely removed and the aggregate particles exposed leaving an even-pebbled texture.
 - 2. An appearance ranging from fine granite to coarse conglomerate depends on the size and grading of the aggregate used.
- D. Floated Surface Finish
 - 1. Flat work – Strike off and use a floated surface finish.
 - 2. Bridge decks and approach slabs – machine finish unless otherwise permitted.

3.8 CONCRETE SURFACE FINISHING

- A. Give all formed concrete surfaces at least an ordinary surface finish except as specified otherwise.
- B. Use other types of finishes as required in addition to the ordinary surface finish.
- C. Provide a rubbed finish for repaired surfaces that cannot meet ordinary surface finish requirements due to irregularities, honeycombing, excessive surface voids, discoloration, and other defects.

3.9 CONCRETE SURFACE FINISHING PROCEDURES

- A. Ordinary Surface Finish
 - 1. Remove all fins and projections after removing forms.
 - a. Clean, point, and true all honeycomb spots, broken corners or edges, cavities made by form ties, and other holes and defects.
 - b. Keep all areas to receive mortar saturated with water for at least 30 minutes before mortar placement.
 - 2. Use a mortar of cement and fine aggregate for pointing, not more than one hour old, mixed in the proportions used in the grade of concrete being finished.
 - 3. Cure the mortar patches and rub to blend with surrounding concrete.

4. Tool and free all joints of mortar and concrete.
 - a. Leave the full length of the joint filler exposed with clean and true edges.
- B. Rubbed Finish
 1. Wet the concrete surface as soon after form removal as conditions permit, paint with grout, and rub with a wooden float until the surface is covered with a lather of cement and water.
 - a. A thin grout of one part cement, one part fine sand may be used in the rubbing.
 - b. Let this lather set for at least three days then rub lightly with a fine carborundum stone until smooth.
 2. Use a mechanically operated carborundum stone to finish the surface of hardened concrete at least four days after placing.
 - a. Finish in the same manner as ordinary surface finish.
 - 1) Let the lather set for at least 7 days before lightly rubbing with a fine carborundum stone until smooth.
 3. Commercial grade rubbing mortar may be used if authorized by Engineer.
- C. Wire Brush or Scrubbed Finish
 1. Scrub the surface with stiff wire or fiber brushes using a solution of muriatic acid – one part acid, four parts water as soon as forms are removed and while the concrete is relatively green.
 2. Wash the entire surface once the scrubbing produces the desired texture.
 - a. Use water mixed with 5 percent by volume ammonium hydroxide to remove all traces of the acid.
- D. Floated surface finish on flat work other than bridge decks and approach slabs:
 1. Striking Off
 - a. Carefully rod and strike off the surface with a strike board following the cross sections and grades shown after compaction.
 - b. Allow for camber as required.
 - c. Operate the strike board longitudinally or transversely and move it forward with a combined longitudinal and transverse motion so that neither end is raised from the side forms during the process.
 - d. Keep a slight excess of concrete in front of the cutting edge at all times.
 2. Floating
 - a. Use longitudinal or transverse floating or both to create a uniform surface.

- b. Longitudinal floating is required except in places where it is not feasible.
 - 3. Longitudinal Floating
 - a. Work the longitudinal float operated from foot bridges with a sawing motion while holding it parallel to the road centerline.
 - b. Pass gradually from one side of the pavement to the other.
 - 1) Move the float forward $\frac{1}{2}$ of its length and repeat operation.
 - c. Substitute machine floating if equivalent results are produced.
 - 4. Transverse Floating
 - a. Operate the transverse float across the concrete surface by starting at the edge and slowly moving to the center and back again to the edge.
 - 1) Move the float forward $\frac{1}{2}$ of its length and repeat the operation.
 - b. Preserve the crown and cross section of the concrete surface.
 - 5. Straightedging
 - a. Test the concrete surface for trueness with a straightedge after the longitudinal floating has been completed and the excess water has been removed while the concrete is still plastic.
 - b. Furnish and use an accurate 10 ft straightedge held parallel to the road centerline in contact with the surface.
 - c. Check the entire area immediately filling depressions with freshly mixed concrete, then strike off, consolidate, and refinish.
 - d. Cut down and refinish high areas.
 - e. Continue the straightedge testing and re-floating until the concrete surface is at the required grade and contour.
- E. Floated Surface Finish for Bridge Decks and Approach Slabs
 - 1. Machine finish exposed surfaces unless otherwise permitted.
 - 2. Finish concrete by striking off and floating the surface.
 - 3. Allow the Engineer enough time to inspect finishing machines during daylight hours before concrete placement.
 - 4. Provide lighting facilities that adequately light the work area when placing and finishing operations are not completed during daylight hours.
 - 5. Extend finishing machine rails beyond both ends of the scheduled placement and allow sufficient distance to permit the float to fully clear the concrete.

6. Use adjustable rails set to provide the finished grade elevations shown, installed to prevent springing or deflection under the weight of the finishing equipment, and placed to operate without interruption over the entire surface being finished.
7. Place screed machine parallel to the abutments and bents within 10 degrees.
8. Support screed rails to prevent movement during placing of the concrete.
9. Attach a measuring device to the screed face and pass it over the area.
10. Place concrete in a uniform heading approximately parallel to the screed machine.
11. Limit the rate of placing to allow enough time to finish the surface before initial set.
12. Continuously place concrete the full length of the structure or superstructure unit unless otherwise shown or authorized.
13. Provide sufficient material, equipment, and manpower to place deck concrete at a rate of at least 25 yd³/hour.
14. Strike off the surface to the required elevations with the finishing machine immediately after placing and consolidating the concrete.
15. Do not add water to the concrete in front of or behind the screed.
16. Obtain authorization for the strike-off method and equipment.
 - a. Maintain satisfactory performance.
 - b. Use equipment capable of finishing concrete within the surface tolerances specified.
 - c. Maintain satisfactory consolidation and surface tolerance to prevent shutdown and rejection of the equipment.
17. Furnish a 10 ft straightedge to check the surface tolerance, placed both longitudinally and transversely, immediately behind the screed machine and hand-finished areas.
18. Correct irregularities greater than 1/8 inch from the straightedge, before additional placement, and immediately fill depressions with concrete and refinish.
19. Cut down and refinish high areas.
20. Continue straightedge testing and corrective measures until the entire surface is free of observable departures from the straightedge.

- F. Final texturing for bridge decks and approach slabs – a textured hardened finish:
1. Use a texture process that produces regular 1/8 inch wide transverse grooves spaced randomly from 1/2 inch to 3/4 inch on centers and 1/8 inch deep.
 2. Keep the finished surface free from porous spots and surface irregularities.

3. Furnish a work bridge that follows the finishing machine to facilitate texturing and application of the curing compound.
4. Check the surface smoothness for acceptance after the concrete has hardened.
5. Remove irregularities by grinding if the surface deviates more than $\frac{1}{8}$ inch from a 10 ft straightedge. Refer to Section 02701.
 - a. Depth of grinding must be authorized by the Engineer before any grinding operations begin.

3.10 CONCRETE CURING

- A. Refer to Section 03390.

3.11 FORM REMOVAL

- A. Obtain authorization from the Engineer before removing forms.
- B. Remove struts, stays, and braces that hold the forms in correct shape and alignment when no longer necessary.
- C. Remove all forms from the concrete surfaces.
 1. Do not use a method of form removal likely to cause overstressing of the concrete.
- D. Remove supports to permit the concrete to uniformly and gradually take the stresses due to its own weight.
- E. Do not remove forms used in ornamental work, railings, parapets, and exposed vertical surfaces for at least twelve hours after placement.
- F. Always remove forms before removing shoring from beneath beams and girders to determine the condition of columns.
- G. Removing Falsework
 1. Do not remove falsework supporting the deck of rigid frame structures until the fill has been placed in back of the vertical legs.
 2. Keep falsework and forms in place under slabs, beams, and girders for 14 days after the day of last concrete placement.
 - a. Slab forms with a clear space of less than 10 ft may be removed after seven days.
 3. Keep forms and falsework in place in cold weather according to the authorized cold weather concreting plan.

- H. Patch formed surfaces within 24 hours after form removal.
1. Cut back and remove all projecting wire or metal devices used for holding the forms in place and that pass through the body of the concrete at least 1 inch beneath the surface of the concrete.
 2. Remove lips of mortar and irregularities caused by form joints.
 3. Fill small holes, depressions, and voids with cement mortar mixed in the same proportions as that used in the body of the work.
 4. Obtain a solid uniform surface by chipping away coarse or broken material to patch larger holes or honeycombs.
 - a. Cut away feathered edges to form faces perpendicular to the surface.
 - b. Apply epoxy adhesive to patch area according to manufacturer's recommendations.
 - c. Fill the cavity with stiff mortar composed of one part portland cement to two parts sand thoroughly tamped into place.
 - d. Pre-shrink the mortar by mixing it approximately 20 minutes.
 - 1) Vary the time according to manufacturer's recommendations, temperature, humidity, and other local conditions.
 - e. Float the surface of this mortar with a wooden float before initial set.
 - f. Keep the patch wet for five days.
 - g. Rub patches on exposed surfaces to blend them with surrounding concrete after curing.
 - h. Add coarse aggregate to the patching material when patching large or deep areas.
 - i. Make a dense, well-bonded, and properly cured patch.
- I. Areas with extensive honeycombing will be rejected.
- J. Apply the following requirements after fully removing all the closure joint forms if inserts are placed along the bottom edges of the precast concrete deck panels to form the closure pour joints:
1. Cut off cast-in-place anchors at least 1 inch below the face of slab and repair according to this Section, Article 3.12, paragraph H.
 2. Fill all voids with dry-pack mortar flush with the bottom of slab.
 3. Fill voids created by the removal of re-usable concrete anchors with dry-pack mortar flush with the bottom of slab.
 4. Dry-pack mortar will be composed of one part portland cement to two parts sand.

3.12 SUPERSTRUCTURE

- A. Deck – Do not place parapet forms or parapet for at least seven days after deck placement and until the deck has attained the specified 28 day minimum compressive strength based on field cured cylinders, or leave all falsework in place and design it to carry all additional loads that are part of the parapet placement process.
 - 1. Do not allow the installation of the parapet and parapet forms to interrupt the curing of the deck and approach slabs when installed before curing is complete.
- B. Slab Span – Place concrete in one continuous operation.
- C. Cast-In-Place T-Beams
 - 1. Place concrete in one or two continuous operations – first to the top of the girder stems and second to completion, unless otherwise shown.
 - 2. Obtain a bond between the stem and slab that is positive and mechanical and secured by means of shear keys or roughened surface in the top of the girder stem.
- D. Do not place the approach slab until the sleeper slab concrete has been in place at least seven days or has attained 75 percent of the specified 28 day compressive strength based on field cured cylinders.

3.13 SUBSTRUCTURE

- A. Concrete in Columns and Bent Stems
 - 1. Allow footing concrete to set until it has attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before placing column forms when column is being placed on a footing.
 - 2. Place concrete in one continuous operation.
 - 3. Allow concrete to set at least two days and until it has attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before placing caps.
 - 4. Do not place concrete in the superstructure until the columns have been stripped and authorized.
- B. Substructure Concrete
 - 1. Do not place the superstructure load on the bents or abutments until they have been in place at least seven days and attained 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

- C. Do not backfill abutments, wingwalls, and retaining walls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
 - 1. Do not interfere with curing.

3.14 BOX CULVERTS

- A. Allow base slab and footing to attain 75 percent of the specified 28 day minimum compressive strength based upon field cured cylinders before constructing the remainder of the culvert.
- B. Construct side walls and top slab monolithically unless the wall height exceeds 10 ft.
 - 1. Keep the construction joints vertical and at right angles to the axis of the culvert.
- C. Construct shear keys in the top of the side walls for anchoring the top slab when side walls and top slab are not placed monolithically.
- D. Construct wingwalls monolithically.
- E. Do not backfill until the concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.
- F. Apply a waterproofing membrane to the top slab and side walls of all concrete box culverts for the full length of the structures.

3.15 HEADWALLS

- A. Allow apron and pipe collar to attain 75 percent of the specified 28 day minimum compressive strength based on field cured cylinders before the remainder of the headwall is constructed.
- B. Construct wingwalls monolithically.
- C. Do not backfill headwalls and wingwalls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.16 CONCRETE SLOPE PROTECTION

- A. Preparing Subgrade
 - 1. Prepare the area to be paved by smoothing and shaping the berms and slopes and excavating for the cut-off walls.

2. Fill and compact subgrade – Refer to Section 02056.
 - a. Furnish extra material to properly finish the slopes when required.
 - b. Compact all soft and yielding material resulting in a firm and substantial subgrade of uniform density.
 3. Thoroughly spray the area with water before placing the concrete.
 4. Obtain the Engineer's authorization for all surfaces before placing concrete.
- B. Placing Concrete
1. Do not place concrete upon spongy, frozen, or unstable surfaces.
 2. Provide concrete of a consistency that it can be placed on the slopes without deformation.
 3. Complete all horizontal grooves and vertical joints as shown.
 4. Complete the entire slope protection in one placement if possible or terminate the placement with a construction joint located in the horizontal grooves or vertical joints.
 5. Finish concrete using a Floated Surface Finish according to this Section, Article 3.10.
- C. Seal Joints and Closures – Refer to 07921.

3.17 RETAINING WALLS

- A. Allow footing concrete to set until it has attained 75 percent of its specified 28 day minimum compressive strength based on field cured cylinders before placing wall forms.
- B. Do not backfill walls until all concrete has been in place at least 7 days and has attained 100 percent of the specified 28 day minimum compressive strength based on field cured cylinders.

3.18 MISCELLANEOUS CONSTRUCTION

- A. Bearing Areas
 1. Finish bridge seat bearing areas high and rub or grind to grade level within an allowable tolerance of $\pm 1/16$ inch and within a tolerance of $\pm 1/8$ inch of the elevation shown.
 2. Do not grout under bearing plates.

3.19 CLEANUP

- A. Remove falsework and falsework piling to 2 ft below the finished ground line, rubbish, and temporary building materials before final inspection.

END OF SECTION

SECTION 03311

BRIDGE DECK JOINT CLOSURE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal and closure of expansion joints in existing bridge decks and parapets.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03152: Concrete Joint Control
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03310: Structural Concrete
- E. Section 03390: Concrete Curing

1.3 REFERENCES

- A. ASTM A 653: Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B. ASTM C 307: Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
- C. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- D. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- E. ASTM C 1339: Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Deck Concrete
 - a. Class AA(LS) according to Section 03055.
 - 2. Other concrete
 - b. Class AA(AE) according to Section 03055.
 - 3. Do not use high early strength concrete, except as shown.
- B. Reinforcing Steel
 - 1. Coated reinforcing steel according to Section 03211.
- C. Doweled Anchors
 - 1. Coated doweled anchors according to Section 03211.
- D. Galvanized Sheet Metal
 - 1. 16 gauge according to ASTM A 653.
- E. Rigid Plastic Foam – Type 9 according to ASTM C 578.
- F. Epoxy Grout
 - 1. Provide a minimum compressive strength of 3,000 psi in 24 hours and 5,000 psi in 28 days according to ASTM C 579.
 - 2. Provide a minimum tensile strength of 2,000 psi according to ASTM C 307.
 - 3. Provide an effective bearing area of 95% according to ASTM C 1339.
- G. Joint Sealer (Structures) – Refer to Section 03152.
- H. Backer Rod – Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

- A. Debris Containment
 - 1. Prevent debris from falling into streams and onto pedestrian areas, traffic areas, and railroad tracks.

3.2 REMOVE CONCRETE

- A. Concrete Saw Cuts
 - 1. Saw cut concrete surface 1 inch deep along perimeter of concrete removal area.
- B. Use jackhammer method to remove existing concrete.
 - 1. Removal of Concrete Slab – Use 90 pound class hand-operated jack hammers or smaller.
 - a. Use 45 pound class hand-operated jack hammer or smaller when removing concrete within 6 inches of girders and diaphragms that are to remain.
 - 2. Operate jack hammers at an angle greater than 45 degrees as measured from the deck surface.
- C. Remove existing joint armor steel and existing joint materials.
- D. Protect existing electrical conduit from damage where encountered.
- E. Remove loose or fractured concrete.
- F. Clean existing concrete and steel surfaces.

3.3 REINFORCING STEEL

- A. Existing Reinforcing Steel
 - 1. Thoroughly clean reinforcing steel that will remain in place of corrosion and adhering materials by sandblasting.
 - 2. Remove and replace any reinforcing steel with 25 percent or greater section loss.
 - a. Cut and remove deteriorated existing reinforcing steel bars.
 - b. Match the size of the new reinforcing steel bar to the existing bar.
 - c. Provide lap lengths as shown.
- B. New Reinforcing Steel and Doweled Anchors
 - 1. Place reinforcing steel after sandblasting operations are complete.

3.4 PLACE CONCRETE

- A. Use epoxy grout to create a smooth, flat, uniform surface on concrete girders and diaphragms as shown.
 - 1. Cure according to manufacturer's installation instructions.
- B. Saturate existing concrete surfaces with water before placing concrete.
- C. Form, place, and finish concrete according to Section 03310.
- D. Cure concrete according to the requirements for cast-in-place concrete closure pours in bridge decks and approach slabs in Section 03390.

END OF SECTION

SECTION 03338

PRECAST SUBSTRUCTURE ELEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast substructure elements for bridges such as foundations, columns, bent caps, abutment stems, and wall stems.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03056: Self-Consolidating Concrete (SCC)
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03310: Structural Concrete
- E. Section 03390: Concrete Curing
- F. Section 03575: Flowable Fill

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. AASHTO M 36: Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- D. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
- E. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
- F. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing

- G. ASTM A 706: Deformed and Plain Low-Allow Steel Bars for Concrete Reinforcement.
- H. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
- I. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- J. ASTM D 2240: Rubber Property – Durometer Hardness
- K. Precast Concrete Institute (PCI) Design Handbook
- L. UDOT Quality Management Plan

1.4 DEFINITIONS

- A. Working Points – Identifiable points of reference between elements to be connected.
 - 1. Identified point locations provide a basis for measurement
 - a. The working point at the top of the foundation allows for an identifiable location for an elevation measurement, for example.
- B. Working Lines – Reference lines connecting working points.
 - 1. Typically oriented along the length of elements to be connected.
 - 2. Provide a basis for aligning elements located along the working line.
 - 3. Provide a reference for the verification of length between working points.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of fabricated materials for review.
 - a. Include the following:
 - 1) Locations and details of lifting inserts, hardware, and devices.
 - 2) Type and amount of additional reinforcing required for lifting.
 - 3) Minimum compressive strength required before handling the precast elements.
 - 4) Details of vertical adjusting hardware.
 - b. Include supporting engineering calculations.

2. Erection Drawings for precast concrete members for review.
 - a. Include the following:
 - 1) A work area plan depicting items such as utilities overhead and below the work area, drainage inlet structures, and protective measures.
 - 2) Equipment to be used to lift substructure elements including cranes, excavators, lifting slings, sling hooks, and jacks. Include crane charts, crane locations, and operation radii.
 - 3) Equipment that will be used for the assembly of the substructure.
 - 4) Methods of providing temporary support of the elements. Include methods of adjusting and securing the element after placement.
 - 5) Procedures for controlling both horizontal and vertical tolerance limits. Include details of alignment jigs including bi-level templates for reinforcing anchor dowels.
 - 6) Methods for placement of flowable bedding concrete for spread footings. Add grout ports in the footings to facilitate the bedding process if required.
 - 7) Method, sequence, and equipment for forming grout voids and installing the structural non-shrink grout.
 - 8) Methods of forming closure pours including the use of backer rods. Do not assume that the backer rods will restrain the pressure from the grout in vertical grout joints. Provide additional forming to retain the backer rod.
 - 9) Methods for curing grout and closure pour concrete.

B. Materials

1. Structural Non-Shrink Grout
 - a. Certificate of Compliance.
 - b. Warranty letter stating that Contractor guarantees the structural non-shrink grout against material and installation defects such as bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
 - 1) The warranty period starts on the date of Physical Completion.
 - 2) Include in the letter
 - a) State Project Designation
 - b) State Project Name
 - c) State Structure Numbers
 - d) Contractor, Distributor, and Manufacturer Name

- 3) The warranty covers 100 percent of the Structural Non-Shrink Grout materials and installation costs.
- C. Repair Procedure
1. Written procedure for defects and breakage of precast elements for review.
- D. Casting and Shipping Schedules
1. A casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
 2. A shipping schedule for information at least 14 calendar days before shipping precast substructure elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
1. Precast elements
 - a. Class AA(AE) concrete according to Section 03055.
 - b. Self-Consolidating Concrete (SCC) according to Section 03056.
 2. Bedding Concrete
 - a. Flowable Fill according to Section 03575.
 - b. Self-Consolidating Concrete (SCC) according to Section 03056.
 - c. Class B(AE) concrete according to Section 03055.
 - 1) Place before setting precast element.
- B. Reinforcing Steel
1. Refer to Section 03211.
 2. Use reinforcing steel according to ASTM A 706 for vertical reinforcing in the bent columns, transverse reinforcing in the bent columns, and bar passing from the columns into the foundation or bent cap.
 3. Use reinforcing steel according to AASHTO M 31 for other substructure elements.
- C. Structural Non-Shrink Grout
1. Use structural non-shrink grout for joints between precast elements as shown.
 - a. Use gray, cementitious grout, containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.

- b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
- c. Meet the requirements of AASHTO T 160 with the exception that the Contractor supplied cube molds will remain intact with a top firmly attached throughout the curing period.
- d. Refer to Table 1 for structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
*Properties	Requirements	ASTM	AASHTO
Accelerated Weathering Tested Medium Accepted Weight Loss	<3% White Utah Road Salt <15% @ 300 Cycles		T 161
Compressive Strength	≥3,000 psi @ 24 hours >5,000 psi @ 7 days		T 106
Accepted Bond Strengths	>1,000 psi @ 24 Hours	C 882 as modified by C 928 8.5	
Length Change	No expansion after 7 days		T 160

* Certified test results from an AASHTO accredited testing laboratory will suffice for acceptance.

- D. Grouted Splice Couplers
 - 1. Refer to Section 03211.
- E. Continuous Butt Welded Hoops
 - 1. Refer to Section 03211.
- F. Corrugated Steel Pipe
 - 1. Refer to AASHTO M 36.
- G. Leveling Devices
 - 1. Use fabricated steel leveling devices as shown.
 - a) Alternate devices may be used provided the devices can support the anticipated loads.
- H. Vertical Joint Seals
 - 1. Use natural rubber or neoprene sheet with a durometer of 50-60 according to ASTM D 2240.

- I. Lifting Devices
 - 1. Use lifting devices that can support the required vertical and horizontal forces with the applicable safety factors according to the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
- J. Steel Items
 - 1. Galvanize steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

2.2 FABRICATION

- A. The use of cast-in-place concrete will not be considered for substitution.
- B. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for precast concrete products according to the Department Quality Management Plan 505 - Precast-Prestressed Concrete Structures.
- C. Construct precast elements to the tolerances specified by PCI or National Precast Concrete Association (NPCA) and as shown.
- D. Finish the precast elements according to Section 03310.
 - 1. Trowel finish the exposed surfaces of precast concrete elements.
- E. Attain a minimum compressive strength of 500 psi before stripping the form.
 - 1. Maintain concrete curing during form removal and member handling.
- F. Permanently mark each precast element with date of casting and supplier identification. Stamp markings in fresh concrete.
- G. Refer to Section 03390 for curing requirements.

2.3 QUALITY CONTROL

- A. Precast Substructure Elements
 - 1. Document test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of cast
 - c. Concrete cylinder test results
 - d. Quantity of used concrete and the batch printout
 - e. Form stripping date and repairs if applicable
 - f. Location/number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period

- h. Lifting device details, requirements, and inserts
- B. Structural Non-Shrink Grout
 - 1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.

PART 3 EXECUTION

3.1 GENERAL PROCEDURE FOR INSTALLATION OF ELEMENTS

- A. Follow the authorized erection drawings.
 - 1. Resubmit the drawings for review if changes are warranted due to varying site conditions.
- B. Dry fit adjacent precast elements in the shop.
- C. Establish working points, working lines, and benchmark elevations before placing elements.
- D. Check the condition of the receiving bonding surface before connecting elements, remove items such as dust, rust, and debris according to the recommendations of the grouted splice coupler manufacturer.
- E. Place elements in the sequence, and according to the methods outlined in the erection drawings.
 - 1. Adjust the height of each element with leveling devices or shims.
- F. Mix structural non-shrink grout just before its use according to the manufacturer's instruction.

3.2 FOUNDATIONS

- A. Set foundation in the proper horizontal and vertical location.
 - 1. Check for proper alignment within tolerances as described.
- B. Adjust vertical leveling devices before full release of the element from the crane to facilitate the vertical adjustment process.
 - 1. Check for proper grade within tolerances as described.
- C. Check the spacing of dowels or grouted splice couplers between adjacent foundations that are to support common elements in future stages of construction.
 - 1. Use bi-level templates and jigs.
 - 2. Adjust the location of the foundation if required.

- D. Place bedding concrete through the ports for spread footings .
 - 1. Start from the center of the footing and proceed toward the outside edges.
 - 2. Verify that bedding concrete is filling the entire void between the footing and the subgrade.
- E. Place concrete in voids around pile tops as shown for foundations supported on drilled shafts or piles.
 - 1. Allow this concrete to flow partially under the pile cap.
 - 2. The entire underside of the cap need not be filled with concrete.
- F. Do not remove temporary supports or proceed with the installation of elements above the foundation until the compressive test result of the cylinders for bedding concrete or pile connection concrete has reached the specified minimum values.

3.3 BENT COLUMNS

- A. Survey the elevation of the element directly below the column.
 - 1. Provide shims to bring the bottom of the column to the required elevation.
- B. Measure the elevation of the top of the shim stack and the top of the projecting dowels.
 - 1. Verify that the elevations and dowel extensions are within tolerances as described.
- C. Check the dowel spacing or grouted splice couplers between adjacent columns that will support common elements in future stages of construction.
 - 1. Use bi-level templates and jigs.
 - 2. Adjust the location of the foundation if required.
 - a. Maintain vertical alignment of columns within tolerances as described.
- D. Set the column in the proper horizontal location.
 - 1. Check for proper horizontal and vertical alignment within tolerances as described.
 - 2. Adjust the shims and reset the column if the column is not within tolerance.
- E. Install the grouted splice couplers according to Section 03211 once the connection geometry is established and checked.
- F. Install temporary bracing if required in the erection drawings.

- G. Allow the grout in the grouted splice coupler to cure until the grouted splice coupler can resist 100 percent of the specified minimum yield strength of the bar before removing temporary bracing and proceeding with installation of components above the bent column.
 - 1. The required grout strength is based on the certified test report. Refer to Section 03211.
 - 2. Verify the strength of the grout by testing cube samples. Refer to this Section, Article 2.3B.

3.4 BENT CAPS

- A. Survey the elevation of the column directly below the cap.
 - 1. Use shims to bring the bottom of the cap to the required elevation.
 - 2. Measure the elevation at the top of the shim stack and the top of the projecting dowels.
 - 3. Verify that the elevations and dowel extensions are within tolerances as described.
- B. Set the cap in the proper horizontal and vertical location.
 - 1. Check for proper horizontal and vertical alignment within tolerances as described.
 - 2. Remove and adjust the shims and reset the cap if the cap is not within tolerance.
- C. Install the grouted splice couplers according to Section 03211 once the connection geometry is established and checked.
- D. Install temporary bracing if required in the erection drawings.
- E. Allow the grout in the coupler to cure until the grouted splice coupler can resist 100 percent of the specified minimum yield strength of the bar before removing temporary bracing and proceeding with installation of components above the pier cap.
 - 1. The required grout strength is based on the certified test report. Refer to Section 03211.
 - 2. Verify the strength of the grout by testing cube samples. Refer to this Section, Article 2.3B.

3.5 WALL PANELS

- A. Wall panels include:
 - 1. Cantilever Abutment Stems
 - 2. Wingwall stems
 - 3. Integral abutment pile cap stems
 - 4. Abutment backwalls and cheekwalls

- B. Wall panels supported on precast concrete elements (foundation or stem).
1. Survey the elevation of the base directly below the panel.
 - a. Provide shims to bring the bottom of the panel to the required elevation.
 - b. Measure the elevation of the top of the shim stack and the top of the projecting dowels.
 - c. Verify that the elevations and dowel extensions are within tolerances as described.
 2. Set the panel in the proper horizontal and vertical location.
 - a. Check for proper horizontal and vertical alignment within tolerances as described.
 - b. Remove and adjust the shims and reset the panel if the panel is not within tolerance.
 3. Install the grouted splice couplers according to Section 03211 once the connection geometry is established and checked.
 4. Install temporary bracing if required in the erection drawings.
 5. Allow the grout in the coupler to cure until the grouted splice coupler can resist 100 percent of the specified minimum yield strength of the bar before removing temporary bracing and proceeding with installation of components above the panel.
 - a. The required grout strength is based on the certified test report. Refer to Section 03211.
 - b. Verify the strength of the grout by testing cube samples. Refer to this Section, Article 2.3B.
 6. Place concrete inside the blockouts and cure if the panels contain corrugated pipe blockouts.
 7. Place structural non-shrink grout in joints between precast abutment and backwall segments after leveling jacks and temporary supports are removed.
 - a. Do not apply additional dead loads or live loads to the precast backwall segments until the structural non-shrink grout has reached a strength of 500 psi based on manufacturer's recommendations.
- C. Wall panels supported on piles or drilled shafts (integral abutments).
1. Set the panel in the proper horizontal and vertical location.
 - a. Check for proper alignment within tolerances as described.
 2. Adjust the leveling devices before full release from the crane if vertical leveling devices are used.
 - a. This will reduce the amount of torque required to turn the bolts in the leveling devices.
 - b. Check for proper grade within tolerances as described.
 3. Check the spacing of dowels or grouted splice couplers between adjacent panels that will support common elements in future stages of construction.
 - a. The use of bi-level templates and jigs is recommended.

- b. Adjust the location of the panel if required.
4. Place concrete around pile tops as shown.
 - a. Allow concrete to flow partially under the panel.
 - b. The entire underside of the panel need not be filled with concrete.
5. Do not remove temporary supports, or proceed with the installation of elements above the panel until the compressive test result of the cylinders for the pile connection concrete has reached the specified minimum values.
6. Place structural non-shrink grout in joints between precast abutment and backwall segments after leveling jacks and temporary supports are removed.
7. Do not apply additional dead loads or live loads to the precast abutment segments until the structural non-shrink grout has reached a strength of 500 psi based on manufacturer's recommendations.

3.6 PRECAST BEAM SEATS

- A. Set beam seat in the proper horizontal location.
 1. Check for proper alignment within tolerances as described.
- B. Adjust vertical leveling devices.
 1. Check for proper grade within tolerances as described.
- C. Install temporary bracing if required in the erection drawings.
- D. Pour or pump structural non-shrink grout through the blockouts in the seat.
 1. Start from the center of the seat and proceed toward the outside edges.
 2. Verify that grout is filling the entire void between the seat and the substructure element below.
- E. Grind beam seat to achieve the seat elevation tolerance as described, if required.
 1. Grind to a maximum depth of $\frac{3}{8}$ inch.

END OF SECTION

SECTION 03339

FULL-DEPTH PRECAST CONCRETE DECK PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Full-depth precast concrete deck panels for bridge decks.
- B. Structural non-shrink grout placed in girder camber strips, shear stud blockouts, and blockouts in the bridge precast concrete deck panels to produce a finished deck.
 - 1. This is not for grouting post-tensioning ducts.
- C. Welded shear studs on new and existing steel girders and on new precast concrete girders. Adhesive dowelled anchors in existing concrete or precast concrete girders.
- D. Longitudinal post-tensioning of precast concrete panels.

1.2 RELATED SECTIONS

- A. Section 02982: Bridge Concrete Grinding
- B. Section 03152: Concrete Joint Control
- C. Section 03055: Portland Cement Concrete
- D. Section 03056: Self-Consolidating Concrete (SCC)
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 03251: Post-Tensioning Concrete
- G. Section 03310: Structural Concrete
- H. Section 03390: Concrete Curing
- I. Section 03412: Prestressed Concrete

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

- B. AASHTO M 169: Steel Bars, Carbon and Alloy, Cold-Finished
- C. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives
- D. AASHTO M 270: Structural Steel for Bridges
- E. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
- F. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
- G. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
- H. AASHTO/AWS D1.5 Bridge Welding Code
- I. ASTM A 109: Steel, Strip, Carbon (0.25 Maximum Percent), Cold Rolled
- J. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- K. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
- L. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- M. PCI Design Handbook
- N. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Shop drawings of fabricated materials for review.
 - a. Include the following:
 - 1) Locations and details of lifting inserts, hardware, or devices.
 - 2) Type and amount of additional reinforcing required for lifting.
 - 3) Locations and details of vertical adjusting hardware.

- 4) Type and size of longitudinal post-tensioning hardware, anchorage assembly, ducts, blockouts, and local zone reinforcement.
- 5) Minimum compressive strength attained before handling the precast elements.
- 6) Additional Calculations.
 - a) Design local zone reinforcing for post-tensioning assembly.
 - b) Show that tensile stresses on both faces do not exceed the modulus of rupture during the handling, fabrication, shipping, and erection of the panel.
- b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
- c. Include supporting engineering calculations.
2. Erection Drawings for precast concrete deck panels for review.
 - a. Include the following:
 - 1) Crane charts
 - 2) Crane and pick locations
 - 3) Cables and lifting equipment
 - 4) Load distribution
 - 5) Panel erection and sequence
 - 6) Sequence used to level panel
 - 7) Method, equipment, and sequence for forming the camber strips and installing the structural non-shrink grout.
 - 8) Method of forming closure pours at joints between precast panels.
 - b. Obtain the Department's approval when shown.
3. Structural Non-Shrink Grout
 - a. Submit for review the proposed method, sequence, and equipment for forming grout voids and installing the structural non-shrink grout 14 calendar days before beginning installation of structural non-shrink grout.

B. Materials

1. Structural Non-Shrink Grout
 - a. Certificate of Compliance.
 - b. Warranty letter stating that the Contractor guarantees the structural non-shrink grout against material and installation defects such as bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
 - 1) The warranty period starts on the date of Substantial Completion.

- 2) Include in the letter
 - a) State Project Designation
 - b) State Project Name
 - c) State Structure Numbers
 - d) Contractor, Provider, and Installer Name
 - 3) The guarantee covers 100 percent of the Structural Non-Shrink Grout materials and installation costs.
- C. Repair Procedure
 - 1. Written repair procedures for defects and breakage of precast elements for review.
- D. Casting and Shipping Schedules
 - 1. A tentative casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
 - 2. A tentative shipping schedule for information at least 14 calendar days before shipping precast substructure elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Precast panels with mild reinforcement
 - a. Class AA(LS) concrete according to Section 03055, or
 - b. Self-consolidating concrete according to Section 03056
 - 2. Precast panels with prestressing steel
 - a. Class AA(LS) concrete or self-consolidating concrete according to Section 03412
- B. Reinforcing Steel
 - 1. Refer to Section 03211.
- C. Vertical Adjusting Hardware
 - 1. Provide fabricated steel vertical adjusting hardware as shown.
- D. Embedded Blind Pocket Blockouts
 - 1. Use cold formed rectangular steel tubing according to ASTM A 500 Grade B.
 - 2. Use a steel top plate according to AASHTO M 270 Grade 36. Higher strength grades of steel may be substituted with approval.
 - 3. Galvanize the steel assembly after fabrication according to AASHTO M 111.
 - 4. Use plastic pipe for grout ports and vents.

- E. Lifting Devices
1. Use devices that provide support for required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
 2. Use a device that will have 2¾ inch top cover and 1 inch bottom cover after installation. This may require partial removal of the device after installation.
- F. Structural Non-Shrink Grout
1. Use structural non-shrink for girder camber strips, shear stud blockouts, shear key blockouts, and other blockouts shown.
 - a. Use gray, cementitious grout, containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
 - b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
 - c. Use a mix design according to Section 03055 if adding more than 15 lb of coarse aggregate (size No. 8 or larger) per 50 lb bag of structural non-shrink grout.
 - d. Meet the requirements of AASHTO T 160 with the exception that the Contractor supplied cube molds will remain intact with a top firmly attached throughout the curing period.
 - e. Refer to Table 1 for structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
*Properties	Requirements	ASTM	AASHTO
Accelerated Weathering Tested Medium Accepted Weight Loss	<3% White Utah Road Salt <15% @ 300 Cycles		T 161
Compressive Strength	>3,000 psi @ 24 hours >5,000 psi @ 7 days		T 106
Accepted Bond Strengths	>1,000 psi @ 24 Hours	C 882 as modified by C 928 8.5	
Length Change	No expansion after 7 days		T 160

* Certified test results from an AASHTO accredited testing laboratory will suffice for acceptance.

- G. Prestressing Steel and Post-tensioning Hardware
1. Refer to Section 03412 for pre-tensioned concrete.
 2. Refer to Section 03251 for post-tensioning.

- H. Shear Studs
 - 1. Use headed anchor studs according to dimensions shown.
 - 2. Use steel according to AASHTO M 169.
 - 3. Use a low carbon grade steel suitable for welding according to ASTM A 109 for the caps if steel flux-retaining caps are used.
- I. T-Headed Bars
 - 1. Refer to Section 03211.
- J. Adhesive for Doweled Anchors
 - 1. Refer to AASHTO M 235 for epoxy resin adhesive.
- K. Backer Rod
 - 1. Refer to Section 03152.
- L. Miscellaneous Steel Items
 - 1. Galvanize miscellaneous steel items permanently cast into structural concrete elements. Galvanize hardware left in place after construction. Refer to AASHTO M 111.

2.2 FABRICATION

- A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the UDOT Quality Management Plan 505: Precast/Prestressed Concrete Structures.
- B. Do not place concrete into forms until materials have been inspected and verified by the Engineer.
- C. Construct panels to tolerances shown.
- D. Perform prestressing according to Section 03412.
- E. Finish the precast concrete deck panels according to Section 03310. Texture the top surface of the elements according to the requirements of Section 03310 for final texturing of bridge decks.
- F. Refer to Section 03390 for curing requirements.
- G. Permanently mark each precast unit with date of casting and supplier identification. Stamp markings in fresh concrete.
- H. Attain a minimum compressive strength of 500 psi before stripping the form. Maintain concrete curing during form removal and member handling.

2.3 QUALITY CONTROL

- A. Precast Deck Panels
 - 1. Document test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of cast
 - c. Concrete cylinder test results
 - d. Quantity of used concrete and the batch printout
 - e. Form-stripping date and repairs if applicable
 - f. Location/number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period
 - h. Lifting device details, requirements, and inserts
- B. Structural Non-Shrink Grout
 - 1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.

PART 3 EXECUTION

3.1 INSTALL WELDED SHEAR STUDS ON NEW AND EXISTING STEEL GIRDERS AND ON NEW PRECAST CONCRETE GIRDERS

- A. Install welded shear studs at the locations shown.
- B. Weld shear studs to steel girders or plates embedded in precast concrete girders according to AASHTO/AWS D1.5.
 - 1. Adjust studs as necessary to provide clearance for bolts in existing bolted splices.
 - 2. Use method and equipment recommended by the manufacturer of the studs.
 - 3. Field weld studs using automatic end welding.
 - 4. Use equipment with adequate capacity for the size of stud welded.

3.2 INSTALL ADHESIVE DOWELED ANCHORS IN EXISTING CONCRETE OR PRECAST CONCRETE GIRDERS

- A. Field drill holes in the top flange of existing concrete and precast concrete girders.
 - 1. Locate girder reinforcing steel before drilling holes.
 - 2. Avoid drilling through reinforcing steel.
- B. Install anchors according to manufacturer's recommendations. Refer to Section 03211.

3.3 PLACE PRECAST CONCRETE DECK PANELS

- A. Fully brace concrete girders or steel girders before placing panels.
- B. Place the precast concrete deck panels as shown.
 - 1. The use of cast-in-place concrete is not an acceptable alternative for precast panels.
- C. Check the grade of the deck panels after deck panels are placed and adjusted to provide the elevations shown.
 - 1. Check the grade before post-tensioning of the deck panels, if applicable.
- D. Provide vertical adjustment in the sequence defined in the erection plan to bring panels to the elevations shown.
 - 1. Adjust vertical adjusting hardware to within 15 percent of each other to provide proper distribution of panel weight to the supporting girders.
- E. Prevent shifting of the precast concrete deck panels during the joining of the deck panels after the proper grade is achieved.

3.4 LONGITUDINAL POST-TENSIONING

- A. Cure precast panels 28 days before tensioning post-installed cables or rods unless otherwise noted.
- B. Clean and remove debris from blockouts.
- C. Grout shear key between panels.
- D. Do not begin stressing operations until the concrete reaches the strength and age designated on the plans.
 - 1. Stress strands within 72 hours of transverse joint grouting.
- E. Do not post-tension until the shear key grout has attained a compressive strength of 1,000 psi (based on manufacturer's data).
- F. Install strands as shown.
- G. Fully tension strand and grout ducts according to Section 03251.
 - 1. Complete post-tensioning before grouting girder camber strips and shear stud grout pockets.

3.5 INSTALLATION OF HEADED T BARS AND ANCHORS

- A. Install according to Section 03211.

3.6 PREPARATION AND INSTALLATION OF STRUCTURAL NON-SHRINK GROUT

- A. Clean and remove debris from the camber strips and blockouts before placing the structural non-shrink grout.
- B. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, or contaminant other than water.
- C. Form the girder camber strips as shown after installing shear studs at the locations shown.
- D. Pre-test grout material installation under field conditions in a grout pocket and camber strip mock-up to determine grout flowability and whether subsequent cracking will occur. Include in the mock-up at least two shear stud pockets and a camber strip that is the same configuration as the actual bridge.
 - 1. The Engineer may determine modifications to the grouting process.
 - 2. Proceed with grouting process as modified by the Engineer.
- E. Saturate surface dry (SSD) surfaces receiving structural non-shrink grout.
- F. Mix and place structural non-shrink grout following manufacturer's recommendations for preparation and installation.
 - 1. Mix structural non-shrink grout just before use according to the manufacturer's instructions.
- G. Grout the girder camber strips using structural non-shrink grout.
 - 1. Place structural non-shrink grout in the girder camber strips in a continuous operation within a panel.
- H. Grout the shear stud blockouts using structural non-shrink grout.
 - 1. Structural non-shrink grout in the shear stud blockouts can be placed as part of the placement of the structural non-shrink grout in the girder camber strips.
- I. Do not allow voids in the grout for the girder camber strips and shear stud blockouts.

- J. Do not apply superimposed dead loads or live loads to the precast concrete deck panels until the structural non-shrink grout in the shear stud blockouts and the girder camber strips has reached a strength of 1,000 psi based on manufacturer's published data.
- K. Fill surface voids with non-shrink grout including lifting device blockouts and grout ports.
- L. Texture top surface of grouted blockouts and voids according to Section 03310 for bridge decks.
- M. Cure structural non-shrink grout according to manufacturer's recommendation.
- N. Finish grout flush or a maximum of $\frac{1}{8}$ inch above adjacent panels.
 - 1. Correct blockout and void profiles in excess of $\frac{1}{8}$ inch higher than the adjacent panel through surface grinding.
 - 2. Remove and replace blockouts and voids for profiles finished below top of adjacent panels.

3.7 DECK GRINDING

- A. Profile grind the deck and approach slabs according to Section 02982 after panels are in place, grouting and closure pours are complete, and the specified minimum 28 day compressive strength is achieved.

END OF SECTION

SECTION 03340

PRECAST APPROACH SLABS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete approach slab elements for bridges.
 - 1. The use of cast-in-place concrete is not an acceptable alternative for precast approach slabs.

1.2 RELATED SECTIONS

- A. Section 02755: Concrete Slab Jacking
- B. Section 02982: Bridge Concrete Grinding
- C. Section 03055: Portland Cement Concrete
- D. Section 03056: Self-Consolidating Concrete (SCC)
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 03310: Structural Concrete
- G. Section 03390: Concrete Curing
- H. Section 03575: Flowable Fill

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- C. AASHTO M 213: Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- D. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)

- E. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete
- F. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
- G. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- H. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
- I. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- J. ASTM D 4635: Polyethylene Films Made from Low-Density Polyethylene for General Use and Packaging Applications
- K. PCI Design Handbook
- L. UDOT Quality Management Plan

1.4 DEFINITIONS

- A. Approach Slab – A structural slab that is designed to span from the rear face of the abutment to the sleeper slab. The purpose of approach slabs is to span over potential settlement of the bridge abutment backfill. The soil under the slab is not intended to support the slab. Support is provided by the bridge abutment and the sleeper slab.
- B. Sleeper Slab – A structural slab that is designed as a transition from the approach slab to the approach roadway pavement. The sleeper slab bears directly on the subgrade and supports the end of the approach slab. The expansion joint between the sleeper slab and the approach slab is used to accommodate the thermal movement of the bridge.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Shop drawings of fabricated materials for review.
 - a. Include the following:
 - 1) Locations and details of lifting inserts, hardware, or devices.
 - 2) Type and amount of additional reinforcing required for lifting.
 - 3) Locations and details of vertical adjusting hardware.
 - 4) Minimum compressive strength required before handling the precast elements.

- b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
 - c. Include supporting engineering calculations.
- B. Materials
 - 1. Structural Non-Shrink Grout
 - a. Certificate of Compliance.
 - b. Warranty letter stating that the Contractor guarantees the structural non-shrink grout against material and installation defects such as bonding, cracking, and spalling failures incurred during normal traffic for a period of two years.
 - 1) The warranty period starts on the date of Substantial Completion.
 - 2) Include in the letter
 - a) State Project Designation
 - b) State Project Name
 - c) State Structure Numbers
 - d) Contractor, Provider, and Installer Name
 - 3) The guarantee covers 100 percent of the Structural Non-Shrink Grout materials and installation costs.
- C. Repair Procedure
 - 1. Written procedure for defects and breakage of precast elements for review.
- D. Casting and Shipping Schedules
 - 1. A tentative casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
 - 2. A tentative shipping schedule for information at least 14 calendar days before shipping precast substructure elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Precast elements
 - a. Class AA(LS) concrete according to Section 03055
 - b. Self-consolidating concrete according to Section 03056.
- B. Bedding Concrete under Sleeper Slabs
 - 1. Flowable Fill according to Section 03575.

- C. Reinforcing Steel
 - 1. Refer to Section 03211.
- D. Structural Non-Shrink Grout
 - 1. Use structural non-shrink grout for bedding under the approach slab at the sleeper slab support as shown.
 - a. Use gray, non-shrink grout concrete containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
 - b. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
 - c. Use a grout that is flowable.
 - d. Meet the requirements of AASHTO T 160 with the exception that the Contractor supplied cube molds will remain intact with a top firmly attached throughout the curing period.
 - e. Refer to Table 1 for structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
*Properties	Requirements	ASTM	AASHTO
Accelerated Weathering Tested Medium Accepted Weight Loss	<3% White Utah Road Salt <15% @ 300 Cycles		T 161
Compressive Strength	≥3,000 psi @ 24 hours >5,000 psi @ 7 days		T 106
Accepted Bond Strengths	>1,000 psi @ 24 Hours	C 882 as modified by C 928 8.5	
Length Change	No expansion after 7 days		T 160

* Certified test results from an AASHTO accredited testing laboratory will suffice for acceptance.

- E. Bond Breaker Material
 - 1. Low density polyethylene sheet according to ASTM D 4635 that will allow sliding of the structural concrete after placement.
 - a. Use 1/8 inch thick sheets.
 - b. Use two layers at each interface.
- F. Steel Bearing Plate
 - 1. Provide a steel bearing plate as shown.
- G. Rigid Plastic Foam
 - 1. Provide expanded polystyrene sheet according to ASTM C 578.

- H. Lifting Devices
 - 1. Use devices that provide support for required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
 - 2. Use devices that provide 2¾ inch top cover and 1 inch bottom cover after installation. This may require partial removal of the device after installation.
- I. Miscellaneous Steel Items
 - 1. Galvanize miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.
- J. Foam under Approach Slabs
 - 1. High Density Polyurethane Foam according to Section 02755.
- K. Premolded Joint Fillers
 - 1. Refer to AASHTO M 153 and AASHTO M 213.

2.2 FABRICATION

- A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the Department Quality Management Plan 505: Precast/Prestressed Concrete Structures.
- B. Do not place concrete into forms until materials have been inspected and verified by the Engineer.
- C. Finish the precast elements according to Section 03310.
 - 1. Texture the top surface of the elements according to the requirements of Section 03310 for final texturing of approach slabs.
- D. Permanently mark each precast element with the date of casting and supplier identification. Stamp markings in fresh concrete.
- E. Attain a minimum compressive strength of 500 psi before stripping the form.
 - 1. Maintain concrete curing during form removal and member handling.
- F. Cure according to Section 03390.

2.3 QUALITY CONTROL

- A. Precast Approach Slab Elements
 - 1. Document test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of casting
 - c. Concrete cylinder test results
 - d. Quantity of the used concrete and the batch printout
 - e. Form-stripping date and repairs if applicable
 - f. Location or number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period
 - h. Lifting device details, requirements, and inserts.
- B. Structural Non-Shrink Grout
 - 1. Warranty the in-place structural non-shrink grout performance and workmanship for two years.

PART 3 EXECUTION

3.1 INSTALLATION OF SLEEPER SLABS AND APPROACH SLABS

- A. General
 - 1. Establish working points, working lines, and benchmark elevations before placing elements.
 - 2. Check the condition of the receiving bonding surface before connecting elements and remove items such as dust, rust, and debris to provide the satisfactory bonding required.
- B. Sleeper Slabs
 - 1. Place sleeper slab elements as shown.
 - a. Adjust the height of each element with leveling devices or shims.
 - 2. Lift sleeper slab segments using lifting devices as shown in the shop drawings.
 - 3. Set sleeper slab in the proper horizontal location.
 - a. Check for proper alignment and grade within shown tolerances.
 - 4. Adjust sleeper slabs before full release from the crane to facilitate the vertical adjustment process.
 - a. Check for proper grade within shown tolerances.
 - 5. Pour or pump bedding concrete through the ports.
 - a. Start from the center of the sleeper slab and proceed toward the outside edges.

- b. Verify that bedding concrete is filling the entire void between the sleeper slab and the subgrade.
 - 6. Do not remove the installation bolts or proceed with the installation of the approach slab until the compressive test result of the cylinders for bedding concrete has reached the specified minimum values.
 - 7. Install bond breaker materials in two layers as shown.
 - a. Seal the edges and joints to prevent concrete or mortar from penetrating the interface between the two sheets. Duct tape is acceptable for this purpose.
- C. Approach Slabs
 - 1. Lift approach slab using lifting devices as shown in the shop drawings.
 - 2. Set approach slab in the proper horizontal location.
 - a. Check for proper alignment and grade within shown tolerances.
 - 3. Survey the top elevation of the approach slab.
 - 4. Adjust vertical leveling devices before full release of the approach slab from the crane. This will reduce the amount of torque required to turn the bolts in the leveling devices.
 - a. Check for proper grade within shown tolerances.
 - 5. Prevent shifting of the precast approach slab panels during installation.
 - 6. Clean and remove debris from the areas that will be grouted before placing the approach slab.
 - 7. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, and other contaminants.
- D. Place Grout
 - 1. Mix structural non-shrink grout just before use according to the manufacturer's instructions.
 - 2. Pre-test grout material installation under field conditions in a similar void mock-up before construction of the approach slab to determine grout flowability. Include in the mock-up at least two fill ports that are of the same configuration as the actual bridge.
 - a. The Engineer may determine modifications to the grouting process.
 - b. Proceed with grouting process as modified by the Engineer.
 - 3. Saturate Surface Dry (SSD) surfaces receiving structural non-shrink grout.
 - 4. Place product following the manufacturer's recommendations for installation.
 - 5. Texture top surface of grouted blockouts according to Section 03310 for approach slabs.

6. Do not apply superimposed dead loads or live loads to the precast approach slabs until the structural non-shrink grout has reached a strength of at least 500 psi or manufacturer's recommendations.
 7. Cure structural non-shrink grout according to manufacturer's recommendations.
- E. Place Foam
1. Pump high density polyurethane foam under the end of the approach slab as shown.
 - a. Start from the center of the approach slab and proceed toward the outside edges or start from one end and proceed continuously to the other end.
 - b. Check that high density polyurethane foam is filling the entire void between the approach slab and the sleeper slab.
- F. Joint Extrusions
1. Set prefabricated joint extrusions as shown.

3.2 GRINDING

- A. Profile grind the approach slab according to Section 02982 after panels are in place, grouting is complete, closure pours are complete, and the specified minimum 28 day compressive strength is achieved.

END OF SECTION

SECTION 03341

PARTIAL-DEPTH PRECAST CONCRETE DECK PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Partial-depth precast concrete deck panels for bridge decks.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03056: Self-Consolidating Concrete (SCC)
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03390: Concrete Curing
- E. Section 03412: Prestressed Concrete

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement
- C. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- D. PCI Design Handbook
- E. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Working Drawings

1. Detailed shop drawings of fabricated products for review.
 - a. Include the following:
 - 1) Details and calculations of the method, materials, and equipment to be used in the prestressing operations, including additions or rearrangement of reinforcing steel and revisions to concrete dimensions from those shown.
 - 2) Method and sequence of stressing.
 - a) Specifications and details of the prestressing steel, working stresses, and other data pertaining to the prestressing operation.
 - b) The proposed arrangement of the prestressing steel in the panels.
 - 3) Locations and details of lifting inserts, hardware, or devices.
 - 4) Type and amount of additional reinforcing required for lifting.
 - 5) Minimum compressive strength attained before handling the precast elements.
 - b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
 - c. Include supporting engineering calculations.
2. Erection Drawings for precast concrete deck panels for review.
 - a. Illustrate the proposed method of erection.
 - b. Provide details of the process including but not limited to the following:
 - 1) Crane charts
 - 2) Crane and pick locations
 - 3) Cables and lifting devices
 - 4) Load distribution and panel weights
 - 5) Panel erection and sequence
 - 6) Sequence used to level panel
 - 7) Method, equipment, and sequence for forming the camber strips.
 - 8) Method of forming closure pours at joints between precast panels.

B. Material Submittals

1. Certifications
 - a. Certification stating the manufacturer's minimum ultimate tensile strength for each sample of prestressing steel.

- b. The certified calibration chart required by Section 03412.
 - 2. Pre-stressing Steel
 - a. Three 6 ft long strand samples from each heat or lot that will be used on the project.
 - b. Testing can require 14 calendar days after the date of receipt.
- C. Repair Procedures
 - 1. Written repair procedures for defects and breakage of precast elements for approval.
- D. Casting and Shipping Schedules
 - 1. A tentative casting schedule for information at least 14 calendar days in advance to make inspection and testing arrangements.
 - 2. A tentative shipping schedule for information at least 14 calendar days before shipping precast substructure elements to the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Use Class AA(LS) concrete according to Section 03055
 - 2. Use self-consolidating concrete (SCC) according to Section 03056
- B. Reinforcing Steel
 - 1. Refer to Section 03211.
- C. Prestressing Steel
 - 1. Grade 270 Low Relaxation Strand, 0.375 inch diameter according to AASHTO M 203.
- D. Lifting Devices
 - 1. Use devices that can support the required vertical and horizontal forces with the applicable safety factors as specified in the Component Handling and Erection Bracing requirements in the PCI Design Handbook.
- E. Rigid Plastic Foam
 - 1. Use rigid plastic foam with a minimum 50 psi compression resistance at 10 percent deformation. Refer to ASTM C 578.
- F. Miscellaneous Steel Items
 - 1. Galvanize miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

2.2 FABRICATION

- A. Use a Department Certified Concrete Precaster or a pre-qualified project site caster for concrete products according to the UDOT Quality Management Plan 505: Precast/Prestressed Concrete Structures.
- B. Do not place concrete into forms until materials have been inspected and verified by the Engineer.
- C. Construct panels to tolerances shown.
- D. Perform prestressing according to Section 03412.
- E. Permanently mark each precast unit with date of casting and supplier identification.
 - 1. Stamp markings in fresh concrete.
- F. Cure concrete according to Section 03390.
- G. Attain a minimum compressive strength of 500 psi before stripping the form.
 - 1. Maintain concrete curing during form removal and member handling.

2.3 QUALITY CONTROL

- A. Precast Deck Panels
 - 1. Document test results. The quality control file will contain at least the following information:
 - a. Element identification
 - b. Date and time of cast
 - c. Concrete cylinder test results
 - d. Quantity of used concrete and the batch printout
 - e. Form-stripping date and repairs if applicable
 - f. Location/number of blockouts and lifting inserts
 - g. Temperature and moisture of curing period
 - h. Lifting device details, requirements, and inserts

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fully brace concrete girders or steel girders before placing panels.

- B. Maintain responsibility for aspects of panel installation during stages of construction including the protection of precast deck panels, the workers, and the traveling public.
- C. Clean bearing surfaces and surfaces that will be in permanent contact before the panels are installed.
- D. Carefully handle materials so that no parts will be cracked, chipped, broken, or otherwise damaged.
- E. Use lifting devices in a manner that will not cause bending or torsional forces.
- F. Erect precast deck panels according to the authorized erection drawings.
- G. Place the precast deck panels as shown.

END OF SECTION

SECTION 03372

THIN BONDED POLYMER OVERLAY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Thin bonded polymer overlay system applied to concrete bridge decks and approach slabs.
- B. Removal of existing polymer overlay from concrete bridge decks and approach slabs.
- C. Repair of damaged areas of a polymer overlay system.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. ASTM C 25: Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
- B. ASTM C 88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C. ASTM C 131: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- D. ASTM C 566: Total Evaporable Moisture Content of Aggregate by Drying
- E. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- F. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete
- G. ASTM D 570: Water Absorption of Plastics
- H. ASTM D 638: Tensile Properties of Plastics
- I. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- J. ASTM D 2240: Rubber Property – Durometer Hardness

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- K. ASTM D 4285: Indicating Oil or Water in Compressed Air
- L. ASTM D 4580: Measuring Delaminations in Concrete Bridge Decks by Sounding
- M. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate
- N. ASTM D 6928: Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- O. ASTM E 274: Skid Resistance of Paved Surfaces Using a Full-Scale Tire
- P. American Concrete Institute (ACI)
- Q. International Concrete Repair Institute (ICRI)

1.4 DEFINITIONS

- A. Polymer Overlay System – A thin bonded polymer overlay applied as a wearing surface consisting of a two-part polymer resin broadcasted with aggregate to refusal before it cures.
- B. Installer – The entity preparing the surface and installing and finishing the polymer overlay system.
- C. Provider – The manufacturer furnishing the polymer overlay system.

1.5 SUBMITTALS

- A. Provider Qualifications for review at least 10 calendar days before ordering material.
 - 1. Include at least the following:
 - a. Company name.
 - b. Name and phone number of the Provider's Technical Support Representative.
 - c. List of projects using the submitted products with at least two years of satisfactory performance under similar environmental conditions as the project in which it is to be applied. Refer to this Section, Article 1.6 B. List the following for each project:
 - 1) Project name
 - 2) Bridge locations (state routes and bridge identifiers)
 - 3) Scope of work
 - 4) Products used
 - 5) Approximate date of the system opening to traffic.

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B. Materials

1. The following information at least 10 calendar days before ordering material:
 - a. Manufacturer's Product Data Sheets and recommended installation instructions.
 - b. Material Safety Data Sheets.
 - c. The Provider's certification stating that the provider is the sole provider of the components of the polymer overlay system and that the components are:
 - 1) In accordance with this Section.
 - 2) Fully compatible with one another.
 - d. The Installer's certification with the Provider's written concurrence that the polymer overlay system is fully compatible with all deck repair materials.
2. Certified test report from an independent nationally recognized laboratory stating that the polymer resins in the polymer overlay system components meet the requirements in this Section.
 - a. Test results must be from within a three year period of the submittal.
3. Certified Test Report from an AASHTO accredited testing laboratory confirming the compliance of the aggregate material with the test requirements of this Section.
 - a. Test results must be from within a one year period of the submittal.

C. Method for mixing of the polymer resins

1. The Provider's written concurrence that the selected mixing method is acceptable and compatible with the polymer overlay system.
2. Mixing ratio of the polymer resins.

D. A warranty letter to the Engineer and the Department Bridge Management Engineer stating that the Contractor guarantees the polymer overlay system against material and installation defects incurred under traffic for a period of 5 years.

1. The guarantee period starts on the date of Physical Completion.
2. Include in the letter:
 - a. State Project Designation
 - b. State Project Name
 - c. State Structure Numbers
 - d. Contractor, Provider, and Installer Name
3. Defects (performance failures) include:
 - a. Spalling: Broken or missing pieces of polymer overlay system.
 - b. Scaling: Visible, exposed, rough surface texture resulting from a loss of aggregate or resin.

- c. Delamination: Visible or audible debonding of the polymer overlay system at the bond line (interface) with the existing bridge receiving surface.
 - d. Cracking: Visible cracks not reflected from a crack in the existing deck.
 - e. Loss of skid resistance: Skid resistance less than 40 as measured according to ASTM E 274.
- 4. The guarantee covers 100 percent of the polymer overlay system materials and installation costs.
- 5. Removal and replacement of the polymer overlay system for failed sections.
- 6. The Department will notify the Contractor of defects to be repaired during the guarantee period.
 - a. Submit detailed plans and procedures of corrective work according to Provider's recommendations and obtain the Department's authorization before commencing work.
 - b. Perform corrective work within 60 days of notification.

1.6 QUALITY CONTROL

- A. Technical Support Representative
 - 1. Provide a Technical Support Representative from the Provider onsite during surface preparation and application of the polymer overlay system on the first day the polymer overlay system is installed on a structure.
 - a. The Technical Support Representative must have a minimum of 3 years of experience with the system and with guiding and assisting installers in the polymer overlay system installation.
 - b. The Technical Support Representative will instruct the workers in proper mixing, application technique, safety precautions, traffic opening time, and environmental requirements.
 - c. The Technical Support Representative must be available for consultation but not necessarily present at the job site for the remaining work.
 - 2. The Department reserves the right to require the Technical Support Representative to be onsite if at any time the Engineer is concerned with the product installation quality.
- B. Prior Performance
 - 1. The selected polymer overlay system must have at least two years of satisfactory performance for non-interstate use and four years of satisfactory performance for interstate use in similar environmental conditions as the project in which it will be applied.

2. Products without the required years of prior satisfactory performance will only be considered for use with approval.
 - a. Do not use for bidding purposes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Polymer Resin
 1. Identify the containers as Part A and Part B and plainly mark with:
 - a. Manufacturer's name
 - b. Manufacturer's address
 - c. Name of the product
 - d. Mixing proportions and instructions
 - e. Lot and batch numbers
 - f. Date of manufacture
 - g. Quantity
 2. Transport to and store on the job site in a dry, weather protected environment away from moisture, and within the maintained temperature range of 60 to 100 degrees F and according to Provider's recommended installation instructions.
- B. Broadcast Aggregate
 1. Store aggregate in a clean, dry location, protected from rain and other moisture sources.
 2. Protect the aggregate from contaminants on the job site.
- C. Handling Liquid Materials
 1. Use protective gloves, clothing, boots, and goggles when directly exposed to the material.
 2. Provide manufacturer's safety data sheets to workers and inspectors.

PART 2 PRODUCTS

2.1 POLYMER OVERLAY SYSTEM

- A. Use a thin bonded polymer overlay system that chemically cures to provide an impervious wearing surface consisting of the following:
 1. Penetrating Crack Filler
 2. Polymer Resin
 3. Broadcast Aggregate
- B. Penetrating Crack Filler
 1. Provide a penetrating crack filler as required by the Provider.

- C. Polymer Resin
1. Two-part Epoxy-Urethane Co-Polymer (Type 1) that meets the requirements of Table 1.
 2. Free of fillers, volatile solvents, and external/conventional flexibilizers.

Table 1

PHYSICAL PROPERTIES OF THE CURED POLYMER RESIN		
Property	Value	Method
Compressive Strength, min. psi	5,000	ASTM C 579
Tensile Strength, min. psi	2,000	ASTM D 638
Tensile Elongation, min. percent	30-80	ASTM D 638
Water Absorption, max. percent by wt.	1.0	ASTM D 570
Shore D Hardness, min. 77°F	60-75	ASTM D 2240
Gel Time, minutes	15-45	ASTM C 881
Adhesion to Concrete	100% failure in concrete	ACI-503-R, Pull Out Test
Flexural Yield Strength, min. psi	3,000	ASTM D 790
Percent Solids	100	

- D. Broadcast Aggregate
1. Thoroughly washed and kiln dried to maximum moisture content of 0.2 percent by weight according to ASTM C 566.
 2. Use aggregate with the properties shown in Table 2 with aggregate gradation according to the requirements in Table 3, or use aggregate with the properties shown in Table 4 with aggregate gradation according to the requirements in Table 5.

Table 2

BASALT OR FLINT AGGREGATE PROPERTIES	
Soundness, ASTM C 88	3.0 max
LA Abrasion, Grade D, ASTM C 131	20.0% max.
Micro Deval Abrasion, ASTM D 6928	10.0% max.
Mohs Scale Hardness	7.0 min.

Table 3

BASALT OR FLINT AGGREGATE GRADATION	
Sieve Size	Percent Passing
0.187 inch; No.4	100
0.078 inch; No.10*	10 – 35
0.033 inch; No.20	0 – 10
* 100 percent of the aggregate has at least one mechanically fractured face for materials being retained on the #10 sieve according to ASTM D 5821.	

Table 4

CALCINED BAUXITE AGGREGATE PROPERTIES	
Soundness, ASTM C 88	3.0 max
LA Abrasion, Grade D, ASTM C 131	20.0% max.
Micro Deval Abrasion, ASTM D 6928	5.0% max.
Mohs Scale Hardness	8.0 min.
Aluminum Oxide, ASTM C 25	87.0% min.

Table 5

CALCINED BAUXITE AGGREGATE GRADATION	
Sieve Size	Percent Passing
0.187 inch; No.4	100
0.132 inch; No.6	95 - 100
0.046 inch; No.16*	0 - 5
* 100 percent of the aggregate has at least one mechanically fractured face for materials being retained on the #16 sieve according to ASTM D 5821.	

2.2 EQUIPMENT

- A. Polymer Overlay Removal
 - 1. Use a diamond tipped grinder or approved method to remove an existing polymer overlay system from the deck.
- B. Metered Mixing
 - 1. Use equipment capable of metering, mixing, and distributing the polymer resin.
 - a. Use equipment that features positive displacement volumetric metering pumps controlled by a hydraulic power unit.
 - b. Use motionless, in-line mixing.
 - 2. Use equipment that is approved by the Provider.

- C. Hand Mixing
 - 1. Use equipment that is approved by the Provider.
- D. Broadcasting Aggregate
 - 1. Use mechanical equipment capable of dispensing the aggregate onto the deck in a uniform manner as required by the Provider.

PART 3 EXECUTION

3.1 POLYMER OVERLAY REMOVAL

- A. Remove the existing polymer overlay as shown or as required by the Engineer.
 - 1. Do not damage concrete deck when removing polymer overlay.

3.2 SURFACE PREPARATION

- A. Surface Defects
 - 1. Repair deck surface defects before installing the polymer overlay system.
 - a. Use a concrete repair material that meets Provider's recommendations and is compatible with the polymer overlay system being used.
 - b. Use concrete repair materials free of magnesium phosphate.
- B. Shot-Blasting
 - 1. Clean the entire concrete deck surface with steel shot blast to remove oil, dirt, rubber, and other materials that may be detrimental to the polymer overlay bonding and curing according to the Provider's recommendations.
 - a. Use sandblasting equipment or mechanical grinders only in areas that cannot be reached with steel shot-blasting.
 - 1) Sandblast or grind before shot-blasting. Refer to ASTM D 4285.
 - 2. Produce a surface relief that meets the International Concrete Repair Institute (ICRI) Surface Preparation CSP 5-7.
- C. Traffic
 - 1. Do not allow traffic on the deck that has been shot-blasted.
 - 2. Only allow the polymer overlay system equipment on cleaned surfaces.

3.3 APPLICATION

A. Concrete Surface

1. Complete deck repairs and surface preparation before applying the polymer overlay system.
2. Clean the concrete surface and apply a penetrating crack filler as required by the Provider.
3. Do not apply the polymer overlay system when it has rained within 24 hours or is expected to rain within 8 hours of application.
4. Verify the moisture content in the concrete substrate does not exceed 4.0 percent when measured by an electronic meter.
5. Apply the polymer overlay system only when the deck and ambient air temperature is a minimum 50 degrees F and rising.
6. Verify that treated surfaces are dry at the time of second application.

B. Mixing

1. Measure and mix the polymer resin components as recommended by the Provider.
 - a. Maintain mix ratios according to the Provider's recommendations.
2. Mix polymer resin immediately before dispensing.
3. Verify the mix ratio by volumetric sampling at the beginning of the application, mid operation, and at the end of the application of each layer.
 - a. Use containers with graduated markings with not less than 5 gallon capacity.
 - b. Remove the static mixer and dispense each component into separate containers.
 - 1) Dispense at least five gallons of the primary component for ratio comparison.
 - 2) Uncontaminated samples may be returned to the reservoirs they were originally dispensed from.
 - c. The Engineer or Technical Support Representative may request additional sampling.

C. First and Second Layers of Overlay

1. Evenly distribute the polymer resin on the clean, dry deck surface at the rate recommended by the Provider.
 - a. Use new notched squeegees, $\frac{3}{16}$ inch minimum, on the first lift of every application to verify sufficient thickness of the overlay.

- D. Overlay Thickness
1. Provide the number of layers and application rates of the liquid in each layer according to the Provider's recommendations.
 2. Provide a total overlay thickness of at least 3/8 inch.
- E. Time Limits for Broadcast Aggregate
1. Use the following maximum time allowed after application of liquid before broadcasting the aggregate in Table 6 unless directed otherwise by the Provider.

Table 6

Time Limits	
Temperature	Maximum Time
Above 90°F	10 minutes
80°F to 90°F	15 minutes
70°F to 80°F	20 minutes
60°F to 70°F	25 minutes
50°F to 60°F	35 minutes

- F. Broadcasting Aggregate
1. Broadcast the aggregate before the polymer begins to gel.
 - a. Cover the surface until no wet spots remain.
 2. Drop the aggregate vertically so the level of the liquid is not disturbed.
- G. Remove Excess Aggregate
1. Completely remove excess and loose aggregate after the overlay has hardened by vacuum or with compressed air before applying subsequent layers according to the Providers recommendations. Refer to ASTM D 4285.
 2. Aggregate may be reused for subsequent lifts if it is removed directly into containers, screened to required gradation, and stored free of contaminants.
- H. Longitudinal Joints in the Overlay
1. Stagger and overlap joints between successive layers 6 to 12 inches so that no ridges appear between two adjacent lanes.
 2. Maintain straight construction joints between adjacent placements and lifts.
- I. Traffic
1. Do not allow vehicles on the polymer overlay while it is curing.

2. Allow traffic on the final layer or in between layers after the resin has cured, as determined by the Provider, and after removal of excess and loose aggregate.
 - a. Brush blast the surface with shot blast according to the Provider's recommendations before applying additional layers when traffic has been allowed on the cured surface between layers.
- J. Work performed contrary to the Technical Support Representatives instructions will be deemed nonconforming.

3.4 LIMITATIONS

- A. New Bridge Decks and Approach Slabs
 1. Cure newly placed concrete for at least 28 calendar days before beginning installation of polymer overlay system.
- B. Bridges constructed offline and moved into their final location by self-propelled modular transporters (SPMT)
 1. Apply the polymer overlay system no sooner than 30 calendar days after setting the bridge in its final location.
- C. Prevent material and debris from falling into streams, pedestrian areas, live traffic, or railroad tracks.

3.5 POLYMER OVERLAY REPAIR

- A. Locate and mark visible polymer overlay repair areas as shown and in the presence of the Engineer.
 1. Sound the polymer overlay around repair area for delamination of the polymer overlay to determine repair limits.
 2. Square off the edges of polymer overlay system repair area six inches beyond the determined limits and parallel to the travel lane.
 3. Saw cut the perimeter of polymer overlay system repair area with a ½ inch deep saw cut.
- B. Remove existing polymer overlay within the repair area according to this Section, Article 3.1.
 1. Sound the concrete deck in the repair area for delamination of the concrete deck to determine the need for structural pothole patching. Refer to ASTM D 4580.

- C. Prepare the deck surface within the repair area according to this Section, Article 3.2.
 - 1. Do not substitute sandblasting or mechanical grinding where shot blasting is required.
- D. Apply the polymer overlay system within the repair area according to this Section.

END OF SECTION

SECTION 03374

MOVE BRIDGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Moving bridges that are constructed offline to their final locations by self-propelled modular transporters (SPMT), lateral slide, longitudinal launch, or crane.
- B. Preparing the bridge staging area and travel path for constructing and moving bridges.
- C. Bridge temporary works for constructing new bridges at a temporary location.
- D. Bridge monitoring.
- E. Assessing and providing remediation before opening bridge to traffic.

1.2 RELATED SECTIONS

- A. Section 02455: Driven Piles
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03310: Structural Concrete
- E. Section 03390: Concrete Curing
- F. Section 03392: Penetrating Concrete Sealer
- G. Section 03412: Prestressed Concrete
- H. Section 03924: Structural Concrete Repair
- I. Section 05120: Structural Steel
- J. Section 06055: Timber and Timber Treatment
- K. Section 09981: Concrete Coating

1.3 REFERENCES

- A. AASHTO LRFD Bridge Construction Specifications
- B. AASHTO LRFD Bridge Design Specifications
- C. UDOT Bridge Management Manual
- D. UDOT Structures Design and Detailing Manual (SDDM)
- E. UDOT Structures Quality Control/Quality Assurance (QC/QA) Procedures

1.4 DEFINITIONS

- A. Deflection Change – Elevation change of the ends of a span relative to its mid-span.
- B. Embedded Items - Scuppers, manholes, anchor bolts or fixtures for bearings, barriers, light-poles, signs, utilities, similar appurtenances, and post-tensioning components - whether permanent or temporary.
- C. Twist – Measurement of the upward or downward deflection of one bridge corner relative to the plane defined concurrently by the elevations of the other three bridge corners.

1.5 SUBMITTALS

- A. Contract Plan Revisions for approval.
 - 1. Provide revised plans detailing dimensional, structural, and other physical changes to the permanent structure necessitated by the construction methods.
 - 2. Design and detail changes according to the AASHTO LRFD Bridge Design Specifications and the UDOT Structures Design and Detailing Manual (SDDM).
 - 3. Provide supporting calculations that include at least the following:
 - a. Summary of revisions and evaluation.
 - b. Calculations showing that the proposed changes do not adversely impact the load carrying capacity of the structure.

- c. Documentation of reductions in load carrying capacity.
 - 1) Update the load rating package according to the current edition of the UDOT Bridge Management Manual when the inventory load rating factor is reduced by 2 percent or more, or when the inventory load rating listed as shown is less than 1.02 and the load carrying capacity of the structure is reduced.
 - 2) Revise the move concept and proposed plan revisions if the revisions result in a load rating factor less than 1.0.
 - a) Load rating factors less than 1.0 will not be accepted.
 - d. Check the system for the load conditions defined in the SDDM if the defined support point locations are changed.
 - 4. Complete and document QC/QA according to the SDDM and UDOT Structures Quality Control/Quality Assurance (QC/QA) Procedures.
 - 5. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah on plans and calculations covering the plan revisions made.
- B. Working Drawings for Bridge Temporary Works for review.
 - 1. Design according to the AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works).
 - 2. Design according to the AASHTO LRFD Bridge Design Specifications and the SDDM when the bridge temporary works and permanent bridge will be used as a public route.
 - 3. Provide drawings defining the geometry, materials, and member sizes of the bridge temporary works.
 - a. Include foundations and details of temporary bents or abutment seats to support the span under construction, including piling, spread footings, or other foundations.
 - 4. Provide calculations indicating the bridge temporary works are adequate for the proposed loads and that settlement or elastic deflections of the bridge temporary works will not adversely affect the bridge moved.
 - 5. Complete and document QC/QA according to the SDDM and UDOT Structures Quality Control/Quality Assurance (QC/QA) Procedures when the bridge temporary works and permanent bridge will be used as a public route.

- C. Lifting, Transporting, and Setting Plan for review.
1. Bridge move using SPMT or similar system
 - a. Provide details of the bridge staging area and travel path including at least the following:
 - 1) Location
 - 2) General layout
 - 3) Surface grading
 - 4) Surfacing material
 - 5) Drainage
 - 6) Environmental protection
 - 7) Material storage areas
 - 8) Access
 - 9) Fences
 - 10) Gates
 - 11) Barriers
 - b. Provide a plan view of the travel path identifying all obstacles requiring removal and replacement, all structures crossed, and all utilities crossed, over and under.
 - c. Provide documentation of utility coordination.
 - 1) Signed confirmations of coordination from the utility owner are required when crossing high pressure gas lines and main water lines.
 - d. Provide details of travel path and planned movements. Include at least the following:
 - 1) Plan view of axle lines.
 - 2) Average effective ground pressure under SPMT or similar units.
 - 3) Maximum single wheel load and anticipated wheel contact patch size.
 - e. Provide a geotechnical evaluation of the bridge staging area and travel path.
 - 1) Identify areas requiring ground improvement.
 - 2) Provide details of required improvements.
 - f. Identify and detail plating or bridging required at utilities.
 - g. Identify bridges crossed.
 - 1) List the structure number.
 - 2) Provide a load rating and evaluation of the structure crossed.
 - h. Identify all pipes, culverts, and walls, for example, within the load influence.
 - 1) List their structure number if available.
 - 2) Provide a load rating/evaluation for the load influencing them.

- i. Define and detail any temporary shoring of structures crossed.
 - 1) Temporary shoring is required if the operating load rating factor is less than 1.
 - j. Identify items requiring temporary removal and replacement.
 - 1) Coordinate with the owner of the item to determine plan requirements and limitations.
 - k. Include the minimum horizontal clearance to the critical obstacle along the path.
 - l. Include the minimum vertical clearance to the critical obstacle along the path.
 - m. Include means to adjust final alignment, elevation, and location to correct for or accommodate deviations from the required setting tolerances if tolerances are not met.
2. Bridge move using lateral slide or longitudinal launch.
- a. Provide details of the bridge staging area and travel path including at least the following:
 - 1) Location
 - 2) General layout
 - 3) Surface grading
 - 4) Surfacing material
 - 5) Drainage
 - 6) Environmental protection
 - 7) Material storage areas
 - 8) Access
 - 9) Fences
 - 10) Gates
 - 11) Barriers
 - b. Provide a plan view of the travel path identifying all obstacles requiring removal and replacement, all structures crossed, and all utilities crossed, over and under.
 - c. Provide documentation of utility coordination.
 - 1) Signed confirmations of coordination from the utility owner are required when crossing high pressure gas lines and main water lines.
 - d. Provide details of travel path and planned movements. Include at least the following:
 - 1) Maximum permissible deviation from the exact slide plane to the constructed slide plane.
 - 2) Maximum possible load on a single slide bearing.
 - 3) Minimum possible load on a single slide bearing.
 - 4) Clearances to fixed obstacles.
 - 5) Plan for controlling and directing the location of the bridge during the slide.

- 6) Maximum deflections along the slide path on the temporary support and permanent structure during the move.
 - e. Provide a geotechnical evaluation of the bridge staging area and travel path.
 - 1) Identify areas requiring ground improvement.
 - 2) Provide details of required improvements.
 - f. Identify and detail plating or bridging required at utilities.
 - g. Include means to adjust final alignment, elevation, and location to correct for or accommodate deviations from the required setting tolerances if tolerances are not met.
- 3. Bridge move using cranes.
 - a. Meet the erection plan requirements in Section 05120 for bridges using steel girders.
 - b. Meet the erection plan requirements in Section 03412 for bridges using concrete girders.
 - c. Include means to adjust final alignment, elevation, and location to correct for or accommodate deviations from the required setting tolerances if tolerances are not met.

D. Move System for review

- 1. Bridge move using SPMT or similar system.
 - a. Provide details of the move system.
 - 1) Move equipment includes the heavy lift system such as SPMTs, jacks, or cranes used to raise or lower the structure, and transport systems such as SPMTs or similar systems used to laterally transport the structure.
 - b. Provide at least the following information:
 - 1) Show the center of gravity (CG) of the bridge being moved and the weight being moved.
 - a) Base the CG and weight on actual, known component dimensions and known material densities.
 - 2) Support locations between the move equipment and the bridge being moved.
 - 3) Maximum vertical load demands and capacities.
 - a) On the controlling axle line.
 - b) On the controlling vertical jack.
 - 4) Maximum vertical load demands and capacity of the weakest component in the vertical load path.
 - 5) Show the number of wheels or axles in each hydraulic group and the geometry of the wheels or axle lines in each hydraulic group.
 - a) Use of at least 3 hydraulic groups is required.
 - 6) Anticipated maximum stroke requirements.

- 7) Stability limits including, but not limited to, the maximum longitudinal and transverse grades along the path and the maximum permitted longitudinal and transverse grades based on system properties.
 - 8) Maximum permitted deviation of support columns from vertical and maximum anticipated deviation of support columns from vertical.
 - 9) Step by step move procedures.
 - a) Include operational details for the control of the lifting, transporting, and setting.
 - b) Include quality control steps. Quality control steps in this context are the steps operators take to assure the system is properly set up, and that the set up matches the submitted drawings.
 - c) Include steps to assure safety during the move.
 - 10) An hour by hour schedule of the move.
2. Bridge move using lateral slide or longitudinal launch.
- a. Provide details of the move equipment.
 - 1) Move equipment includes the heavy lift system (for example, jacks or cranes used to raise or lower the structure), and transport systems (jacks, slide pads, rollers or other systems used to laterally move the structure).
 - b. Include at least the following information:
 - 1) Weight of the system being moved.
 - 2) Minimum and maximum anticipated friction coefficients.
 - 3) Minimum and maximum anticipated slide force.
 - 4) Jack capacity.
 - 5) Maximum capacity over demand ratio of the weakest component along the lateral force system.
 - 6) Stroke length and rate.
 - 7) Method to reverse movement along the travel path.
 - 8) Equipment used to control and direct the location of the bridge during the slide.
 - 9) Step by step move procedures.
 - a) Include operational details for the control of the lifting, transporting, and setting.
 - b) Include quality control steps.
 - c) Quality control steps in this context are the steps operators take to verify the system is properly set up, and that the set up matches the submitted drawings.
 - d) Include steps to provide safety during the move.

- 10) An hour by hour schedule of the move.
3. Bridge move using cranes.
 - a. Included in Lifting, Transporting, and Setting Plan for review of bridge moves using cranes. Refer to this Section, Article 1.5, paragraph C.
- E. Contingency Plan for review.
 1. Identify potentially disruptive events and provide a contingency plan for each.
 2. Address equipment breakdown, delays during the move, and any other risks.
 3. Define key personnel, their responsibilities. and their required actions if any part of the contingency plan must be implemented.
 4. List backup equipment on site and local contacts for replacement parts or service.
 5. Provide detour plan in case road will not reopen as scheduled.
- F. Safety and Communication Plans for review. Include at least the following:
 1. Safety Plan
 - a. Schedule of operations
 - b. Organization of machinery
 - c. Safety gear requirements
 - d. Operational perimeters
 2. Communication Plan
 - a. Public impacts, methods of communication during bridge move, and lead communicator.
 - b. Contact information for:
 - 1) Bridge move supervisor (primary point of contact for the move)
 - 2) Move system supervisor
 - 3) Contractor supervisor
 - 4) Safety supervisor
 - 5) Engineer of record
 - 6) Contractor's engineer
 - 7) Heavy lift engineer
 - 8) Structures Division representative
 - 9) Resident engineer
 - 10) Public involvement liaison.
- G. Monitoring Plan for review.
 1. Submit as working drawings or as a manual.
 2. Include at least the following:
 - a. Description and details of the move monitoring system.
 - 1) Refer to this Section, 3.4C for minimum requirements.

- b. Measuring equipment, procedures, required measurements, and locations of geometry control reference points on the bridge and in the bridge staging area.
 - 1) Measurements may be elevations, dimensions, or other readings.
 - c. Pre-move and move monitoring.
 - d. Warning levels and absolute limit levels
 - 1) Define allowable tolerances and warning levels.
 - a) Set displacement limits to avoid damage to the bridge during the move.
 - b) Set displacement limits that are less than or equal to the limits defined in the contract plans
 - e. Minimum detectable movements and system accuracy.
 - f. Potential remedial actions that must be implemented when measurements exceed the warning levels.
 - g. Required measurements and when they are taken and recorded.
 - 1) Refer to this Section, 3.4C for minimum requirements.
- H. Post move and pre-opening work for review.
 - 1. List activities and anticipated time frames for work requiring completion before opening the bridge to traffic.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Refer to Section 03055.
- B. Reinforcing Steel
 - 1. Refer to Section 03211.
- C. Penetrating Concrete Sealer
 - 1. Refer to Section 03392.
- D. Driven Piles
 - 1. Refer to Section 02455.
- E. Structural Steel
 - 1. Refer to Section 05120.
- F. Timber
 - 1. Refer to Section 06055.

- G. Concrete Coating
 - 1. Refer to Section 09981.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Move the bridge to its final location without damage and loss of strength.
- B. Use methods and procedures that provide adequate safety to the general public during:
 - 1. Construction activities
 - 2. Structure move
 - 3. Erection
- C. Use heavy lift equipment and falsework placed over or adjacent to traveled roadways, navigational or recreational waterways, pedestrian facilities, and any existing commercial, industrial, or other facilities.

3.2 BRIDGE TEMPORARY WORKS

- A. Construct bridge temporary works according to the authorized working drawings.
- B. Verify the following before constructing the new bridge.
 - 1. The temporary support structures are constructed according to authorized working drawings.
 - 2. The support surfaces are constructed to the required elevations and tolerances with sufficient clearances to accommodate the heavy lift system.
- C. Embedded Items
 - 1. Verify that all Embedded Items are in their correct locations and elevations according to the authorized working drawings and before casting concrete in the permanent bridge.
- D. Concrete Casting and Curing
 - 1. Concrete Placement
 - a. Refer to Section 03310.
 - 2. Concrete Curing
 - a. Refer to Section 03390.

3.3 PREPARATION FOR BRIDGE MOVE

- A. Safety and Communication
 - 1. Review the authorized Safety and Communication Plans with all personnel involved with the bridge move.
 - a. Include at least the engineer of record, safety supervisor, heavy lift engineer, contractor's engineer, resident engineer, and Structures Division representative.
 - 2. Conduct a safety meeting immediately before the bridge move to address unforeseen, variable factors with all personnel involved.
- B. Heavy Lift System such as jacking, cribbing, raising, and lowering
 - 1. Follow the authorized Lifting, Transporting, and Setting Plan for jacking, cribbing, raising, and lowering the bridge.
 - a. Adhere to the limitations for jacking with regard to corresponding stability conditions for the heavy lift system and falsework.
 - 2. Implement Contingency Plan in the event of a major breakdown or equipment malfunction.

3.4 BRIDGE LIFTING, TRANSPORTING, AND SETTING

- A. Follow the authorized Lifting, Transporting, and Setting Plan.
- B. Do not lift or attempt to move the bridge until it has attained a minimum age of 21 days since the last casting operation and has attained the specified 28 day minimum compressive strength, unless otherwise authorized.
- C. Monitor the bridge during lifting, transporting, and setting according to the authorized Monitoring Plan.
 - 1. Provide a monitoring system capable of the following:
 - a. Measuring the change in bridge camber at initial lift.
 - b. Measuring the relative twist between adjacent lines of supports at initial lift and during the move.
 - c. Measuring the relative change in elevation between adjacent lines of support at initial lift and during the bridge move.
 - 1) This measurement is not required for bridges moved with two lines of supports.
 - d. Indicating when bridge measurements exceed warning levels and absolute limit levels.
 - 2. Take and record measurements at least as follows:
 - a. Before beginning the move
 - 1) Set the move monitoring system.

- 2) Monitor the bridge through a typical daily temperature cycle using the monitoring system used during the move.
 - a) Record measurements just before dawn of each day and when the bridge reaches the approximate maximum temperature.
 - b. Immediately before the initial lift.
- 3) Record the initial measurements.
 - a) Initial measurements establish the baseline condition of the bridge.
- c. Immediately after the initial lift.
 - 1) Record measurements and compare the bridge to the baseline condition.
 - 2) Calculate the deflection change as the difference between the condition just before to just after the initial lifting of the bridge.
 - 3) Verify that measurements are within tolerance limits.
- d. During the bridge move
 - 1) Continuously monitor the bridge.
- e. When the bridge is aligned and ready for setting, but is not in contact with the final supports.
- f. After setting the bridge in its permanent location.
 - 1) Record a final set of monitoring system measurements.
 - 2) Verify that measurements are within anticipated and allowable tolerance limits specified for permanent elevations.

D. Limit deflection change, twist, and other measurements to the limits defined in the authorized Monitoring Plan.

3.5 SETTING TOLERANCES

- A. Bridge Alignment: Location and Clearances
 - 1. Comply with the following for the final condition of the span after move:
 - a. Do not exceed 1 inch maximum deviation at each end of span from overall longitudinal alignment of an individual span after setting.
 - b. Do not exceed 1 inch maximum deviation from overall transverse location for example for longitudinal position at each line of bearings.

- c. Limit the maximum alignment deviation in both primary plan directions at each end of the span or spans being set to not more than 1 inch or to that required for the accommodation of manufactured expansion joint components and bearings, whichever is less.
 - d. Keep individual elements or surfaces within 1 inch of location with respect to similar matching surfaces at expansion joints such as plane of web or parapet) of adjacent spans, bent, or abutment features in the absence of other constraints.
- B. Bridge Bearings: Elevation and Location
 - 1. Keep the elevations of the bridge bearings for the prefabricated bridge within plus or minus 1/8 inch of required elevations, unless tighter tolerances are required in the plans and the authorized shop drawings.
 - 2. Keep the plan location of bridge bearings with respect to the girders within the limits shown and the authorized bearing shop drawings.
 - 3. Address elevation and plan location deviations that do not meet the tolerances according to the authorized Lifting, Transporting, and Setting Plan.
- C. Expansion Joints
 - 1. Keep the elevations and alignments of surfaces of adjacent spans to accommodate expansion joint devices within plus or minus $\frac{1}{8}$ inch of dimensioned locations, unless tighter tolerances are required according to the expansion joint manufacturer or as shown and in authorized expansion joint shop drawings.
 - 2. Address deviations that do not meet the tolerances according to the authorized Lifting, Transporting, and Setting Plan.

3.6 BRIDGE ASSESSMENT AND REMEDIATION

- A. Visually inspect the bridge and substructure in the presence of the Engineer post move and before opening bridge to traffic.
 - 1. Identify spalling and cracking that requires repair.
 - a. Indicate whether the repair must be completed before opening to traffic or if the repair can be completed at a later date.
- B. Repair spalling. Refer to Section 03924.

- C. Repair cracks
1. Refer to Table 1 for classification of crack treatments.

Table 1

Crack Treatments			
Crack Width	Location	Treatment	Related Section(s)
Less than or equal to 0.016 inches	Substructure and superstructure	Penetrating concrete sealer or concrete coating per project requirements	Refer to 03392
Greater than 0.016 inches and up to and including 0.25 inches	Substructure and superstructure	Epoxy injection	Refer to 03924
Greater than 0.25 inches	Substructure and superstructure	Delamination repair and penetrating concrete sealer or concrete coating per project requirements	Refer to 03392 and 03924

3.7 RESTORATION OF ORIGINAL CONDITIONS

- A. Restore conditions of the bridge staging area, travel path, and demolition site according to the agreements with each property owner and to the satisfaction of the Engineer.

END OF SECTION

SECTION 03375

BRIDGE DECK METHACRYLATE RESIN TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. A high molecular weight methacrylate (HMWM) resin treatment applied to bridge decks and approach slabs.
- B. Concrete crack repair for bridge decks and approach slabs.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. ASTM C 882: Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear
- B. ASTM D 323: Vapor Pressure of Petroleum Products (Reid Method)
- C. ASTM D 638: Tensile Properties of Plastics
- D. ASTM D 1475: Density of Liquid Coatings, Inks, and Related Products
- E. ASTM D 2196: Rheological Properties of Non-Newtonian Materials by Rotational Viscometer
- F. ASTM D 3278: Flash Point of Liquids by Small Scale Closed-Cup Apparatus
- G. ASTM D 4285: Indicating Oil or Water in Compressed Air
- H. ASTM E 274: Skid Resistance of Paved Surfaces Using a Full-Scale Tire

1.4 DEFINITIONS

- A. Installer – The entity preparing the surface, installing, and finishing the HMWM resin treatment.
- B. Provider – The manufacturer furnishing the HMWM resin treatment.

1.5 SUBMITTALS

- A. Placement plan for review at least 14 calendar days before beginning HMWM resin treatment placement. Include at least the following:
 - 1. Schedule of work for each bridge.
 - a. Include major work items such as preparing concrete deck surface, sealing cracks, applying HMWM, applying sand, and curing time.
 - 2. Description of equipment for preparing deck surface and applying HMWM resin.
 - 3. A table showing the range of gel time and final cure time in minutes for the allowable ambient temperature range, in increments of 10 degrees F.
 - 4. Application rate if outside the limit shown in this Section, Article 3.3, paragraph E.
 - a. Include documentation from the Provider supporting the application rate.
 - 5. Description of equipment for applying and removing excess sand.
 - 6. Storage and handling of HMWM resin components.
 - 7. Disposal of excess HMWM resin and containers.
- B. Materials
 - 1. Manufacturer's Product Data Sheets and recommended installation instructions for the components of the HMWM resin treatment.
 - 2. Manufacturer's Safety Data Sheets for the components of the HMWM resin treatment for information.
 - 3. Certificate of Compliance for the components of the HMWM resin treatment (resin and sand, for example).
 - a. Certificate of Compliance must be accompanied by test results from an independent nationally recognized laboratory.
- C. Skid Test Results according to ASTM E 274
 - 1. Before application of the HMWM resin treatment skid resistance test results.
 - 2. After application of the HMWM resin treatment skid resistance test results.

1.6 QUALITY CONTROL

- A. Technical Support Representative
 - 1. Provide a Technical Support Representative from the Provider onsite during surface preparation and application of the HMWM resin treatment on the first day the HMWM resin treatment is used on a structure.
 - a. The Technical Support Representative must instruct the workers in proper mixing, application technique, safety precautions, traffic opening time, and environmental requirements.
 - b. The Technical Support Representative must be available for consultation but not necessarily present at the job site for the remaining work.
 - 2. The Engineer may waive the requirement for the Technical Support Representative to be onsite if the Installer can demonstrate that the Installer's superintendent for the work has performed at least five satisfactory applications of the HMWM resin treatment on similar bridges in similar environments.
 - a. The Technical Support Representative must be available for consultation throughout the duration of the application.
 - b. The Department reserves the right to require the Technical Support Representative to be onsite if at any time the Engineer is concerned with the product installation quality.

1.7 HANDLING, STORAGE, AND DELIVERY

- A. Ship and store the materials away from one another in a manner that prevents leakage and spillage from one container to contact other containers.
- B. Store materials in original containers according to the Provider's requirements and with manufacturer's label.
 - 1. Include on label manufacture date, batch number, trade name, brand, and quantity.
- C. Store sufficient quantities of HMWM resin treatment materials according to the Provider's requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. HMWM Resin Treatment
 - 1. Use a treatment consisting of a HMWM resin and silica sand.
- B. HMWM Resin
 - 1. Use a low viscosity, non-fuming, 100 percent solid, high molecular weight methacrylate resin meeting the properties listed in Tables 1 and 2.

Table 1

Physical Properties		
Property	Requirement	Test Method
Viscosity	25 cps, maximum (Brookfield RVT with UL adaptor, 50 RPM at 77°F)	ASTM D 2196
Density	7.5 lbs/gal, minimum at 77°F	ASTM D 1475
Tensile Elongation	3% minimum	ASTM D 638
Flash Point	180°F minimum	ASTM D 3278
Vapor Pressure	0.02 psi, maximum at 77°F	ASTM D 323
Bond Strength	1500 psi minimum	ASTM C 882

Table 2

Performance Properties	
Cure Speed	Time
Bulk Cure	Less than 3 hours at 77°F
Surface Cure	Less than 6 hours at 77°F
Gel Time	25-75 minutes at application temperature, 1.7 fluid ounce sample

- C. Silica Sand
1. Commercial quality dry blast sand containing less than 0.5 percent moisture.
 2. Have the following gradation:

Table 3

Silica Sand	
Sieve Size	Percent Passing (by weight)
No. 8	95-100
No. 20	0-5

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. Do not begin surface preparation until skid resistance testing has been performed.
- B. Shot-Blasting
1. Clean the concrete surface by automatic shot-blasting. Remove all traces of curing compound, laitance, grease, dirt, dust, salt, oil, asphalt, paint, striping, coating, or foreign materials.
 - a. Use a cleaning unit equipped with a dust collector that recycles the abrasives.
 - b. Do not gouge the surface during shot-blasting operations.
 - c. Collect and dispose of the removed concrete surfacing.
 - d. Clean the surface and cracks with oil free compressed air. Refer to ASTM D 4285.
- C. Perform additional surface preparation if recommended by the Technical Support Representative.
- D. Cover deck joints, plug deck drains and scuppers, seal cracks on underside of deck, and use other protective measures to protect waterways and bridge components. .
- E. Do not allow traffic on the deck that has been shot-blasted.

3.2 INSTALLATION

- A. Install according to the requirements in this Section.
 - 1. Follow the Provider's recommendations that are more stringent than the requirements listed in this Section.
- B. The deck surface must be dry at the time of HMWM resin treatment.
- C. Pre-treat visible cracks by filling the cracks and keeping them full.
 - 1. Pre-fill large cracks (wider than 1/32 inch) with sand before applying resin.
 - 2. Treat crack by ponding resin over the crack for between 5 and 10 minutes allowing gravity to feed material into the crack.
 - 3. Repeat ponding procedure until each crack is sealed.
- D. Mix the HMWM resin components according to the Provider's requirements and apply the resin to the deck within five minutes of completing mixing.
- E. Evenly distribute the HMWM resin on the clean, dry deck surface at the Provider's recommended rate, but not greater than 125 ft²/gal.
 - 1. Application rates may vary depending on field conditions.
 - a. Texture and absorption of the surface will determine final coverage rates.
 - b. The Technical Support Representative will assist the Installer in determining application rates.
 - 2. Apply the HMWM resin to refusal.
 - 3. Redistribute excess material using squeegees or brooms.
- F. Broadcast silica sand mechanically over the entire treated area of the bridge deck to obtain a visually uniform coverage of at least 2.0 lb/yd².
 - 1. Apply the sand before the resin gels.
 - 2. Remove excess sand if required by the Technical Support Representative.
 - 3. Remove all loose sand that has accumulated along the face of the parapets, in deck drains, and expansion joints at least 14 calendar days after opening the HMWM resin treatment to traffic.
- G. Apply the material in the morning and evening hours when the temperatures are lower and the cracks are at their most open point.

3.3 LIMITATIONS

- A. Do not use material after the original shelf life date.

- B. Cure concrete in new bridge decks for at least 28 days after placement before applying the HMWM resin treatment.
- C. Do not apply resin within 48 hours after a rain or when more than 10 percent probability of rain is forecast within 4 hours following the application.
- D. Conduct the work in a continuous operation with the HMWM resin treatment application immediately following surface preparation.
- E. Apply HMWM resin treatment only if the deck surface temperature and the air temperature are between 50 degrees F and 90 degrees F and the weather forecast shows air temperatures will remain within that range for at least twelve hours after the application is complete.
- F. Do not permit traffic on the treated surface until the silica sand cover adheres sufficiently to prevent tracking.

3.4 FIELD QUALITY CONTROL

- A. The Department will measure the skid resistance according to ASTM E 274 before and after the application of the HMWM resin treatment to verify that the HMWM resin treatment meets the requirements in Table 4.
 - 1. Coordinate with the Engineer to schedule the skid resistance testing at least 2 weeks before needing the skid resistance test results.

Table 4

Skid Resistance Test Results	
Before Application	After Application
< 40	≥ Before Application
≥ 40	≥ 40

- B. Reapply the HMWM resin and the silica sand if the skid resistance test results after application do not meet the requirements in Table 4.

END OF SECTION

SECTION 03390

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete curing materials and methods.
- B. This section does not apply to cast-in-place Portland Cement Concrete Pavement and Lean Concrete Base Course.
- C. This section does not apply to dry cast precast concrete members, except for precast concrete box and three-sided culvert structures.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03310: Structural Concrete

1.3 REFERENCES

- A. ASTM C 309: Liquid Membrane-Forming Compounds for Curing Concrete
- B. ASTM C 1315: Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
- C. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 CURING COMPOUND

- A. Refer to this Section, Part 3, Tables 1 and 2.
- B. Limit Volatile Organic Compounds (VOC) content to 350 grams / liter maximum.

PART 3 EXECUTION

3.1 CURING MEASURES

- A. Prevent drying of exposed concrete surfaces after placing concrete and until applying the selected curing method.
 - 1. Keep exposed concrete surfaces moist by fogging if the surfaces begin to dry before the selected curing method can be applied.
- B. Cure newly placed concrete to prevent loss of water by one or more of the following methods according to this Section.
 - 1. Forms-in-Place Method (FIPM)
 - a. Cure formed surfaces of concrete by retaining the forms in place without loosening for the specified curing period.
 - b. Complete the cure using one of the methods specified for the element when forms are removed before completing the specified curing period.
 - 2. Water Method (WM)
 - a. Keep concrete surfaces continuously wet by ponding, spraying, or covering with materials that are continuously and thoroughly wet.
 - 1) Acceptable materials for covering concrete surfaces include cotton mats, multiple layers of burlap, or other materials that retain water.
 - 2) Secure the cover materials to prevent wind or other forces from removing them.
 - 3) Keep the cover materials saturated throughout the curing period.
 - b. Do not erode or damage the finish.
 - c. Prevent excess water from impacting traffic on in-service roadways.

3. Liquid Membrane-Curing Compound Method (LMCCM)
 - a. Thoroughly seal exposed concrete surfaces with a liquid membrane-curing compound immediately after finishing operations are completed for exposed concrete surfaces or immediately after forms are removed and necessary patching is complete when forms are removed before the end of the curing period.
 - b. Apply liquid membrane-curing compound uniformly at the rates specified in Tables 1 and 2.
 - c. Immediately repair damage to the curing compound film during the specified curing period by re-spraying.
4. Waterproof Cover Method (WCM)
 - a. Exposed concrete surfaces must be wet before installing cover.
 - b. Cover exposed concrete surfaces with a material that prevents moisture loss from the concrete.
 - 1) Do not use materials that have lost their waterproof qualities.
 - 2) Secure cover to prevent displacement by wind.
 - c. Use this method only when the covering can be secured adequately to prevent moisture loss.
 - d. Maintain the air temperature beneath the cover at not less than 50 degrees F.
 - 1) The use of insulated blankets is permitted.
5. Steam or Radiant-Heat Method (SRHM)
 - a. Use only for precast concrete members manufactured in prequalified plants.
 - b. Use a complete steam or radiant heat curing system that includes 24 hour temperature control and monitoring devices.
 - 1) Use temperature recording devices as necessary to verify that temperatures are uniform throughout the enclosure and within the limits specified.
 - c. Steam Heat Curing System
 - 1) Use a suitable enclosure to contain live steam and minimize moisture and heat losses.
 - 2) Use low-pressure and saturated steam.
 - 3) Maintain 90 to 100 percent relative humidity in the curing enclosure.
 - 4) Do not apply heat directly on the concrete or cause localized high temperatures.
 - d. Radiant Heat Curing System
 - 1) Apply heat by means of pipes circulating steam, hot oil, or hot water, or by electric heating elements.
 - 2) Use a suitable enclosure to contain the heat.

- 3) Minimize moisture loss by covering exposed concrete surfaces with plastic sheeting.
- e. Waiting Period
 - 1) Do not apply the initial application of heat before the initial set of the concrete except to maintain the minimum temperature within the curing enclosure.
 - 2) Maintain the temperature within the curing enclosure at not less than 50 degrees F.
 - a) Live steam or radiant heat may be used to maintain the curing enclosure at the proper minimum temperature.
 - b) Keep the concrete wet during this period.
- f. Curing Period
 - 1) Increase the temperature within the concrete during the initial application of heat at an average rate not to exceed 40 degrees F per hour until the curing temperature is reached.
 - 2) Do not exceed a concrete temperature of 160 degrees F when applying heat.
 - 3) Maintain the concrete temperature at between 50 degrees F and 160 degrees F.
 - 4) Maintain the curing temperature until the concrete achieves the specified strength for terminating the curing.
 - 5) Decrease the concrete temperature at a rate not to exceed 40 degrees F per hour until reaching a temperature of not more than 20 degrees F above the air temperature to which the concrete will be exposed when discontinuing heat.
- g. Transfer the stressing force to the concrete immediately after discontinuing steam curing or radiant heat curing for prestressed members.

C. Prevent exposed concrete surfaces from drying when transitioning between curing methods.

D. Fogging

1. Use fogging when necessary to prevent drying of exposed concrete surfaces.
2. Use fogging equipment with compressed air misters that atomize the water and produce a very fine mist and not a spray.
 - a. Use equipment that allows for adjusting the rate of fogging depending on the conditions that are present.
 - b. Maintain misters at least 5 ft above the concrete surface and aimed in a direction not lower than horizontal.

- c. Do not use fogging to apply excess water to the concrete surface to aid finishing.
 - d. Do not affect the water/cement ratio of the concrete.
 - e. Discontinue fogging when a fine coating of water or sheen is visible on the concrete surface.
 - 3. Do not damage the concrete surface.
- E. Follow the hot and cold weather limitations according to Section 03055.

3.2 CURING COMPOUND APPLICATION

- A. Comply with the following when applying liquid membrane-curing compound to structural elements in bridges, box culverts, headwalls, retaining walls, concrete drainage structures, and concrete slope protection.
- 1. Do not use curing compounds on surfaces that require a rubbed finish or on surfaces of construction joints against which new concrete will be cast, unless approved.
 - a. Completely remove the curing compound before casting new concrete against the surface when curing compound is allowed.
 - 2. Do not use curing compounds on architectural surfaces that require a concrete coating or penetrating concrete sealer and where removal will diminish the texture.
- B. Preparation
- 1. Verify concrete surfaces are ready for curing.
 - a. Complete all patching and surface finishing before applying curing compound.
 - 2. Prepare concrete surfaces and apply curing compound according to product manufacturer's recommendations. Refer to Tables 1 and 2 for application rates.
 - 3. Keep surfaces moist until the curing compound is applied.

3.3 CURE CAST-IN-PLACE CONCRETE

- A. Cure all formed surfaces using the FIPM.
- B. Cure exposed surfaces of newly placed cast-in-place concrete according to the curing methods and curing periods in Table 1.
- 1. Determine the concrete compressive strength using field cured cylinders cured the same as the concrete member when compressive strength is used to determine the curing period. The curing period is the specified number of consecutive days when compressive strength is not used to determine the curing period.

Table 1

Cast-in-Place Concrete Curing Requirements				
Element	Curing Methods for Exposed Surfaces ¹	Curing Period ²	Curing Compound	
			Type	Application Rate
Bridge Decks and Approach Slabs	LMCCM and WM	14 days	ASTM C309, Type I D, Class A	Manufacturer's recommended rate
Closure Pours in Bridge Decks and Approach Slabs	LMCCM and WM	7 days and f'c ³	ASTM C309, Type I D, Class A	Manufacturer's recommended rate
Other Bridge Elements (superstructure, substructure, and foundation elements)	- LMCCM or - WM or - WCM	0.70 f'c or 7 days ³	ASTM C309, Type I D, Class A	100 ft ² /gal
Box Culverts (including wingwalls, and aprons), Headwalls, Retaining Walls, Concrete Drainage Structures, Sign Structure Foundations	- LMCCM or - WM or - WCM	0.70 f'c or 7 days	ASTM C309, Type I D, Class A	100 ft ² /gal
Concrete barrier	- LMCCM or - WM or - WCM	0.70 f'c or 7 days	ASTM C309, Type I D, Class A or ASTM C1315, Type 1, Class A ⁴	100 ft ² /gal
Curbs, gutters, flatwork, sidewalks, driveways, concrete slope protection, and other concrete items not specified	LMCCM	7 days	ASTM C309, Type I D, Class A	100 ft ² /gal
Notes: ¹ Use FIPM for all formed surfaces. Specified curing methods apply to exposed concrete surfaces and any formed surfaces where the forms are removed before the curing period ends. ² f'c = specified 28 day minimum compressive strength. ³ The curing period for bridge elements that use high early strength concrete may be reduced to the greater of 3 days and the time required to achieve the specified 28 day minimum compressive strength. (Refer to Section 03310 for when the use of high early strength concrete is permitted.) ⁴ Use a curing compound meeting ASTM C309 when removal is required.				

- C. Bridge Decks and Approach Slabs
 - 1. Cure the exposed surfaces of newly placed concrete bridge decks and approach slabs for the specified curing period by a combination of the liquid membrane-curing compound method and the water method.
 - 2. Apply membrane-curing compound so that no portion of the deck or approach slab is exposed to the atmosphere for more than 20 minutes after the tining or finishing operation.
 - a. Use a work bridge that follows immediately after the finishing machine to allow application of the curing compound while the concrete is still plastic.
 - 3. Cover the entire exposed surface of bridge decks, approach slabs, curbs, and sidewalks as soon as the concrete is sufficiently set to support the materials. Refer to this Section, Article 3.1 for water method requirements.
- D. Concrete Barrier
 - 1. Broom clean the formed surfaces of the barrier after removing forms.
 - 2. Apply curing compound to exposed concrete surfaces immediately after finishing operations are completed.

3.4 CURE PRECAST CONCRETE

- A. Cure all formed surfaces using the FIPM.
- B. Cure exposed surfaces of newly placed precast concrete according to the curing methods and curing periods in Table 2.
 - 1. Determine the concrete compressive strength using field cured cylinders cured the same as the concrete member when compressive strength is used to determine the curing period. The curing period is the specified number of consecutive days when compressive strength is not used to determine the curing period.

Table 2

Precast Concrete Curing Requirements				
Element	Curing Methods for Exposed Surfaces ¹	Curing Period ²	Curing Compound	
			Type	Application Rate
Precast Concrete Deck Panels (full depth), Precast Approach Slabs, (includes parapets when cast concurrent with precast deck and approach slab panels)	LMCCM and WM	14 days	ASTM C309, Type I D, Class A	Manufacturer's recommended rate
Precast Substructure Elements, Partial Depth Precast Deck Panels (non-prestressed)	- WM or - SRHM	0.7 f'c or 7 days	Not used	Not used
Prestressed Concrete Members (includes all pretensioned concrete members where pretensioning is required in the plans)	- SRHM or - WM or - WCM	Specified release strength (f'ci)	Not used	Not used
Precast Noise Walls, Precast Retaining/Noise Walls, MSE Retaining Wall Panels	- SRHM or - WM or - WCM	0.70 f'c or 7 days	Not used	Not used
Precast Box Culvert Structures and Precast Three-Sided Culvert Structures (wet cast and dry cast)	- SRHM or - WM or - WCM - LMCCM	0.70 f'c or 7 days	ASTM C309, Type I D, Class A	100 ft ² /gal
Wet Cast Concrete Drainage Structures (such as manholes, grade rings, catch basin grade sections, pipe end sections, precast inlets and boxes)	- SRHM or - WM or - WCM - LMCCM	0.50 f'c or 7 days	ASTM C309, Type I D, Class A	100 ft ² /gal
Modular Block (wet cast)	- WM or - WCM or - LMCCM	0.70 f'c or 7 days	ASTM C309, Type I D, Class A	100 ft ² /gal

Table 2 (Continued)

Precast Concrete Curing Requirements				
Element	Curing Methods for Exposed Surfaces ¹	Curing Period ²	Curing Compound	
			Type	Application Rate
Concrete Barrier	LMCCM	7 days and until certified according to QMP ³	ASTM C1315, Type 1, Class A	100 ft ² /gal
PCC Pavement Panels	LMCCM and WM	14 days	ASTM C309, Type I D, Class A	Manufacturer's recommended rate

Table 2 Notes:

¹ Use FIPM for all formed surfaces. Specified curing methods apply to exposed concrete surfaces and any formed surfaces where the forms are removed before the curing period ends.

² f'c = specified 28 day minimum compressive strength.

³ QMP = UDOT Quality Management Plan: Precast-Prestressed Concrete Structures.

- C. Precast Concrete Deck Panels (full depth), and Precast Approach Slabs
 - 1. Refer to this Section, Article 3.3, paragraph C.
- D. Precast Concrete Barrier
 - 1. Broom clean the formed surfaces of the barrier after removing forms.
 - 2. Apply curing compound to exposed concrete surfaces immediately after finishing operations are completed.

END OF SECTION

SECTION 03392

PENETRATING CONCRETE SEALER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Penetrating concrete sealer applied to concrete, masonry, or stone surface.

1.2 RELATED SECTIONS **Not Used**

1.3 REFERENCES

- A. ASTM D 3960: Volatile Organic Compound (VOC) Content of Paints and Related Coatings

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.
- B. A random sample of the penetrating concrete sealer for testing at the Engineer's discretion to verify product compliance.

PART 2 PRODUCTS

2.1 PENETRATING CONCRETE SEALERS

- A. Choose from the following list:
 - 1. Silane
 - 2. Siloxane
 - 3. Silicate
 - 4. Siliconate
 - 5. Organo Silane Ester
 - 6. Styrene Acrylic Copolymer
 - 7. Organo Siloxane
 - 8. Alkylalkoxy Siloxane
 - 9. Alkylalkoxy Silane

- B. Meet VOC content of 350 g/L or less for Reactive Penetrating Sealer and 100 g/L or less for others. Refer to ASTM D 3960.
- C. Can be applied to either new or existing surfaces.
- D. Dries clear without significant change in surface appearance.
- E. Maximum drying time of 1½ hours.
- F. Product can be applied in horizontal, vertical and overhead surfaces.

PART 3 EXECUTION

3.1 PREPARATION

- A. Keep surfaces dry and free of release agents, laitance, dirt, dust, paint, grease, oil, rust and other contaminants.
- B. Remove any curing compound or other incompatible products from the surface of the concrete before applying penetrating sealer.
- C. Use one of the following cleaning methods:
 - 1. Pressure washing – 700 psi min.
 - 2. Shotblasting
 - 3. Sandblasting
 - 4. Etching
- D. Keep concrete surface matrix intact without exposing any large aggregate.
- E. Cure concrete for 28 days before sealer application.
- F. Obtain approval from the Engineer before applying material.
- G. Apply only when the outside air temperature will remain between 45 and 90 degrees F for 24 hours or the manufacturer's recommended cure time, whichever is longer.
- H. Do not apply within 24 hours of a rain event or pressure washing, nor if a rain event is forecasted within 24 hours.

3.2 APPLICATION

- A. Application Rate
 - 1. Apply according to manufacturer's recommendations for each of the following surfaces:

- a. Horizontal
 - b. Vertical
 - c. Overhead
- B. Apply the penetrating concrete sealer evenly at an application rate recommended by the manufacturer.
- C. Do not apply penetrating concrete sealer to portland cement concrete pavement (PCCP) or other roadway surface.
- D. The sealer is considered defective if clouding or chalking occurs after placement.

END OF SECTION

SECTION 03412

PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-tensioning, fabricating, curing, storing, transporting, and erecting precast, prestressed concrete members.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03056: Self-Consolidating Concrete (SCC)
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03390: Concrete Curing
- E. Section 05120: Structural Steel
- F. Section 05822: Bearings

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 169: Steel Bars, Carbon, and Alloy, Cold-Finished
- C. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- D. AASHTO M 270: Structural Steel for Bridges
- E. AASHTO/AWS D1.5: Bridge Welding Code
- F. ASTM C 150: Portland Cement
- G. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- H. ASTM A 307: Carbon Steel Bolts, Studs, and Threaded Rods 60000 PSI Tensile Strength

- I. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- J. ASTM A 563: Carbon and Alloy Steel Nuts
- K. ASTM F 436: Hardened Steel Washers
- L. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
- M. American Institute of Steel Construction (AISC)
- N. Precast/Prestressed Concrete Institute (PCI)
- O. US Military Specifications
- P. UDOT Quality Management Plan

1.4 DEFINITIONS

- A. Working Force – The force remaining in the prestressing steel after prestressing losses have either taken place or been provided for. These losses include concrete creep and shrinkage, concrete elastic compression, steel creep, and anchorage take ups.
- B. Working Stress – The stress remaining in the prestressing steel after prestressing losses have either taken place or been provided for. These losses include concrete creep and shrinkage, concrete elastic compression, steel creep, and anchorage take ups.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of fabricated materials for review.
 - a. Include the following:
 - 1) Details and calculations of the method, materials, and equipment to be used in the prestressing operations, including additions or rearrangement of reinforcing steel and revision in concrete dimensions from that shown.
 - 2) Method and sequence of stressing.
 - a) Specifications and details of the prestressing steel, working stresses, and other data pertaining to the prestressing operation.

- b) Proposed arrangement of the prestressing steel in the members.
 - c) Cutting or release pattern. Include location and detail of hold-down devices and debonded strands.
 - 3) Location, descriptions, and details for embedment items including plates, inserts, sleeves, lifting devices, and other items used for temporary and permanent attachments.
- 2. Erection drawings for precast, prestressed concrete members for review.
 - a. Illustrate the proposed method of erection. Provide details of the process including but not limited to the following:
 - 1) Temporary supports, bracing, guys, dead-men, lifting devices, connection details, and attachments to bridge members.
 - 2) Details for anticipated phases and conditions during erection.
 - 3) The erection schedule and sequence, crane location, crane capacities, location of lifting points on the bridge members, member weights, and other assumed loads during progressive stages of construction.
 - 4) Minimum number and arrangement of items such as primary members, secondary members, and connections that must be installed, braced, and properly connected to provide structural integrity and stability.
 - 5) Incorporate into the plan the requirements from this Section, article 3.1.

B. Material Submittals

- 1. Certifications
 - a. Certification stating the manufacturer's minimum guaranteed ultimate tensile strength for each sample of prestressing steel.
 - b. Documentation of AISC Bridge Component QMS (CPT) Certification for information.
 - c. The certified calibration chart required by this Section, Article 2.7, paragraph B.
- 2. Prestressing Steel
 - a. Three 6 ft long strand samples from each heat or lot that will be used on the project.
 - b. Testing may require 14 calendar days after the date of receipt.

1.6 ACCEPTANCE

- A. Girders may be accepted at a reduced price when the average compressive strength, based on field cured cylinders, is at least 94 percent of the specified 28-day minimum compressive strength.

1. Price reduction factor is as follows:

$$\text{Price Reduction Factor} = 1.00 - 0.30 \left\{ \frac{f'_c - \text{AVG}}{0.06 f'_c} \right\}^2$$

Where:

f'_c = specified 28-day minimum compressive strength in psi.

AVG = average compressive strength of 3 cylinder breaks in psi.

2. Department will calculate the amount paid by multiplying the contract unit price for the girder by the price reduction factor.
3. The Department will reject girders if the average compressive strength of field cured cylinders is less than 94 percent of the specified 28-day minimum compressive strength.
- a. Core tests are not permitted for compressive strength tests.

1.7 HANDLING, STORAGE, AND DELIVERY

- A. Prevent cracking or damaging precast units during handling, storage, and delivery.
- B. Take appropriate measures to prevent member camber from exceeding the tolerances in this Section, Article 2.7 until deck is placed.
- C. Store units with adequate dunnage and bracing.
1. Secure and protect units from movement.
 2. Prevent cracking, distortion, warping, contact with soil, staining, and other physical damage.
 3. Store units with dunnage across full width of each bearing point unless otherwise specified.
 4. Place stored units so identification marks are clearly visible and units can be inspected.
- D. Do not ship prestressed concrete members until tests on concrete cylinders manufactured from the same concrete and cured under similar conditions as the girders, indicate the concrete has attained an average compressive strength equal to or greater than the specified 28-day minimum compressive strength or for seven days after concrete placement, whichever is longer.

- E. Transport precast members in an upright position.
 - 1. Support the members during transportation in approximately the same points they will be supported when installed.
- F. Remove portions of lifting devices protruding above the top of the member, when no longer needed.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Class AA(PS) concrete according to Section 03055.
 - 1. The minimum compressive strength for transfer of prestressing force is as shown, but not less than 4,000 psi.
 - 2. Pay factor for reduced strength in girders is as defined in this Section, Article 1.6.
- B. Self-Consolidating Concrete (SCC) – Refer to Section 03056.

2.2 PRESTRESSING STEEL

- A. Refer to AASHTO M 203. Use 0.5 or 0.6 inch diameter, Grade 270.

2.3 REINFORCING STEEL

- A. Use coated reinforcing steel according to Section 03211.

2.4 ELASTOMERIC BEARING PADS

- A. Refer to Section 05822.

2.5 ZINC RICH PAINT

- A. Refer to US Military Specification MIL-P-24441/20.

2.6 MISCELLANEOUS STEEL ITEMS

- A. Headed Studs – Use steel according to AASHTO M 169.
 - 1. Automatic end welded.
- B. Embedded Plates – Use AASHTO M 270, Grade 36 steel.
 - 1. Galvanize according to AASHTO M 111 after fabrication.
- C. Tapered Sole Plates – Use AASHTO M 270, Grade 50 steel.

- D. Graffiti Cover
 - 1. Plates – Use AASHTO M 270, Grade 36 steel.
 - 2. Bolts – Use ASTM A 307, Grade A steel.
 - 3. Nuts – Use ASTM A 563 steel.
 - 4. Washers – Use ASTM F 436 steel.
 - 5. Galvanize plates according to AASHTO M 111 after fabrication.
 - 6. Galvanize bolts, nuts, and washers according to ASTM A 153, Class C.
- E. Intermediate Diaphragms
 - 1. Connection angles and Plates
 - a. Use AASHTO M 270, Grade 36 steel.
 - 2. Nuts and Bolts
 - a. Use ASTM A 325, Type 1 for steel only connections.
 - b. Use ASTM A 307, Grade A for steel and concrete connections.
 - 3. Washers
 - a. Use ASTM F 959 washers for steel only connections.
 - b. Use ASTM A 307, Grade A for steel and concrete connections.
 - c. Use ASTM F 436 washers for concrete to steel connections.
 - 4. Galvanize connection angles and plates according to AASHTO M 111.
 - 5. Galvanize bolts, nuts, and washers according to ASTM A 153, Class C.
- F. Threaded Rods – Refer to AASHTO M 270, Grade 36.
- G. Welding – Refer to AASHTO/AWS D1.5.
- H. Galvanize structural steel items permanently cast into concrete according to AASHTO M 111.

2.7 FABRICATION

- A. General
 - 1. Use a Department prequalified supplier of precast concrete products according to the UDOT Quality Management Plan 505: Precast/Prestressed Concrete Structures.
 - 2. Comply with camber and dimensional tolerances of PCI MNL 135.
 - 3. Fabricate structural steel according to Section 05120.
 - a. Structural steel for prestressed concrete members requires AISC Bridge Component QMS (CPT) Certification unless otherwise specified.

B. Preparation

1. Equipment used to stress tendons must be accurate including jacks, pressure gauges, and load cells.
 - a. Furnish a certified calibration chart.
 - b. Calibrate each jack and its gauge as a unit with the cylinder extension in the final jacking force position.
2. Calibrate the load cell and provide an indicator to determine the prestressing force in the tendon.
 - a. The range of the load cell must be so that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking stress.
3. The prestressing force may be tested by the Engineer.
4. Provide sufficient labor, equipment, and material to install and support testing equipment at the prestressing tendons and to remove the equipment when testing is completed.

C. Prestressing Steel

1. Clearly mark the shipping package or form with handling instructions and information about the corrosion inhibitor including date, place, safety orders, and instructions for use.
2. Protect against physical damage and corrosion during handling, storing, and shipping.
3. Replace prestressing steel that has damage, loose rust, pitting, or serious corrosion.
 - a. Slight rusting is acceptable if it does not cause visible pits.
4. Do not oil or grease prestressing strand.

D. Pre-tensioning

1. Install and support testing equipment at the prestressing tendons and remove the testing equipment after the testing is completed.
2. Tension prestressing steel with hydraulic jacks so that the force in the prestressing steel is not less than the value shown.
3. Do not allow the initial stress to exceed 70 percent of the specified minimum ultimate tensile strength.
4. Maximum temporary tensile stress (jacking stress) in prestressing steel must not exceed 75 percent of the specified minimum ultimate tensile strength.
5. Anchor the prestressing steel at stresses (initial stress) that result in the ultimate retention of working forces not less than those shown.
6. The stress loss in pretensioned, prestressing steel due to concrete creep and shrinkage, steel creep, and concrete elastic compression is as shown.
7. Check prestressing steel strands in pretensioned members for loss of prestress not more than 12 hours before placing concrete for the members if tensioned individually.
 - a. Use methods and equipment acceptable to Engineer.

8. Re-tension strands that show a loss of prestress in excess of three percent.
9. Increase the calculated prestressing steel elongation in pretensioned members to compensate for the loss in stress when it is tensioned at a temperature appreciably lower than the estimated concrete temperature and the prestressing steel at the time of initial set of the concrete.
 - a. Do not allow the jacking stress to exceed 75 percent of the specified minimum ultimate tensile strength.
10. Do not cut or release prestressing steel in pretensioned members until the concrete in the member has attained the minimum compressive strength specified in this Section, article 2.1.
11. Maintain a minimum lateral eccentricity of prestress when cutting and releasing prestressing steel in pretensioned members.
 - a. Follow the cutting and release pattern in the authorized shop drawings.
12. Cut off pretensioned, prestressing steel flush with the end of the member except when otherwise shown. Clean and paint the exposed strand ends and a 1 inch strip of adjoining concrete with zinc rich paint. Alternatively, cut the strands at least 1 inch back from the girder end, fill the recess with grout, and finish flush with the girder ends.
 - a. Use a wire brush or abrasive blast cleaning to remove dirt and residue not firmly bonded to the metal or concrete surfaces.
 - b. Cover the surfaces with a thick application of zinc rich paint. Thoroughly mix the paint at the time of application and work it into voids in the strands.
 - c. Apply two applications of zinc rich paint to surfaces that are not covered by concrete or mortar.

E. Place Concrete

1. Do not place concrete into forms until the reinforcement and prestressing steel has been inspected and approved by the Engineer.
2. Clean the inside surface of forms of dirt, mortar, and foreign material before concrete placement.
3. Vibrate the concrete internally, externally, or both. Do not vibrate SCC.
4. Avoid displacing reinforcing steel or strands.
5. Finish top surfaces of precast girders, against which cast-in-place concrete will be placed, to a coarse texture by brooming with a stiff, coarse broom.
 - a. Clean surfaces of laitance or other foreign material before shipping.

- F. Cure
 - 1. Cure according to Section 03390.

PART 3 EXECUTION

3.1 ERECTION

- A. Erect prestressed concrete members according to the authorized erection drawings.
- B. Clean bearing surfaces and surfaces that will be in permanent contact before the members are erected.
- C. Use lifting devices in a manner that will not cause bending or torsional forces.
- D. Accurately assemble parts as described and according to the contract documents or authorized erection drawings. Follow match-marks.
- E. Temporarily support, anchor, and brace erected superstructure members as necessary for stability and to resist wind or other loads until they are permanently secured to the structure.
 - 1. Support, anchor, and brace superstructure members as detailed in the authorized erection drawings before allowing traffic under the bridge.
- F. Do not open traffic under a partially erected bridge superstructure unless allowed in the erection drawings or authorized by the Engineer and approved by the Professional Engineer responsible for signing and sealing the erection drawings.

END OF SECTION

SECTION 03575
FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flowable fill.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

- A. AASHTO M 194: Chemical Admixture for Concrete
- B. ASTM D 4832: Preparation and Testing of Controlled Low Strength Material (CLSM) Test

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Batch Proportions
 - 1. Seven days before placement.
- B. Trial Batch
 - 1. Certified test results or conduct laboratory trial batch to verify strength before placement.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement – Refer to Section 03055.
- B. Pozzolan – Refer to Section 03055.
- C. Sand.
- D. Coarse aggregate – Determine a suitable aggregate size and gradation for the intended application.

- E. Admixtures
 - 1. Water reducers and set accelerators. Refer to AASHTO M 194.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Combine materials to meet the requirements for strength and constructability as required. Determine strength from trial batches at 28 days.
 - 1. Minimum strength – 50 psi according to ASTM D 4832.
 - 2. Maximum strength – 150 psi according to ASTM D 4832.
 - 3. Slump: 5 inches to 10 inches.

END OF SECTION

SECTION 03605

APPROACH SLAB JACKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Slab jacking by pumping non-shrink grout or injecting high density polyurethane.

1.2 RELATED SECTIONS

- A. Section 02755: Concrete Slab Jacking
- B. Section 03924: Structural Concrete Repair

1.3 REFERENCES

- A. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.
- B. Certificate of compliance for the materials used.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Equipment capable of supplying a homogeneous product at the appropriate rate.
- B. Certified scales or measuring devices to measure delivered product and to proportion product components.
- C. Concrete drill or saw capable of producing circular holes of adequate size for the appropriate application type.
- D. Elevation measuring devices with an accuracy of 1/8 inch.

- E. Concrete saw capable of cutting a joint in roadway slab just adjacent to end of approach slab.

2.2 NON-SHRINK GROUT

- A. Refer to ASTM C 1107.

2.3 HIGH DENSITY POLYURETHANE

- A. Refer to Section 02755.

PART 3 EXECUTION

3.1 PREPARATION

- A. Establish a final target approach slab profile using an elevation measuring device or string lines.
- B. Clean all adjacent joints before jacking to allow free movement of the slab.
- C. Locate structural steel by ferros scanning or other method approved by the Engineer.
 - 1. Do not damage existing rebar during preparation or installation.
- D. Drill a minimum of four evenly spaced holes into each half of the approach slab where required to obtain uniform grout or polyurethane placement.
 - 1. Drill vertical holes that are round.
 - 2. Drill holes with a maximum diameter of 3 inches.
- E. Do not crack approach slab.
 - 1. Follow Section 03924 to repair approach slab cracks if they develop.
- F. Protect integrity of approach slab drains.
 - 1. Drains in precast approach slabs may require additional preparation and procedures.
 - 2. These must be approved by the Engineer before execution.

3.2 INSTALLATION

- A. Pump, in a pattern, the amount of material required to completely fill the voids underneath the slab.
 - 1. Raise the approach slab to within plus or minus $\frac{1}{8}$ inch from the final targeted approach slab profile.
- B. Remove polyurethane material from the drill holes to the full depth of the approach slab at the completion of the pumping operation and clean the full depth of the holes along the circumference with a wire brush.
 - 1. Dampen the walls of the holes prior to grout placement.
- C. Fill the holes with non-shrink grout. Overfill the holes by $\frac{1}{4}$ inch.
- D. Grind the non-shrink grout used to fill the holes flush with the top of the approach slab.

END OF SECTION

SECTION 03924

STRUCTURAL CONCRETE REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Repair of delamination and cracks in structural concrete elements such as columns, pedestals, bent caps, diaphragms, wingwalls, abutment backwalls, girders, parapets, and deck edges.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete
- D. Section 03390: Concrete Curing

1.3 REFERENCES

- A. AASHTO M 235: Epoxy Resin Adhesives
- B. AASHTO T 106: Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
- C. AASHTO T 161: Resistance of Concrete to Rapid Freezing and Thawing
- D. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- E. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- F. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars
- G. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions for all materials.
- B. Evidence that epoxy injection equipment operators have at least two years of experience in the methods and materials of the selected epoxy injection system for information.
- C. Working Drawings for review.
 - 1. Girder jacking drawings
 - a. Submit when girder jacking is shown.
 - b. Provide the seal of a Professional Engineer or Professional Structural Engineer licensed in the State of Utah.
 - c. Include supporting engineering calculations.
 - 2. Drawings for Temporary Works as shown.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver the materials in unopened packages with labels clearly indicating the following:
 - 1. Name of Manufacturer
 - 2. Manufacturer's product name or product number
 - 3. Manufacturer's lot number
 - 4. Mix ratio
 - 5. Hazardous material rating and appropriate warnings for handling.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Class AA (AE). Refer to Section 03055.
 - 2. Aggregate – $\frac{3}{4}$ inch maximum.
- B. Concrete Repair Mortar
 - 1. Use only products recommended for vertical or overhead application by the manufacturer.

2. Use a product that meets AASHTO T 106 and ASTM C 928 as defined in Table 1.

Table 1

Repair Mortar Type	
Element	Type
Parapets, Diaphragms, and Wingwalls	R1
Deck Edges, Pedestals, Abutments, and Backwalls	R2
Girders, Bent Caps, Columns, and other items	R3

3. R3 concrete repair mortar may be substituted for R1 and R2 at the Contractor's discretion.
 4. Use a product that meets AASHTO T 161 Durability Factor of 95 at 28 days.
 5. Use a product that dries gray in color.
- C. Substrate Coating
1. Use a bonding agent or primer recommended by the concrete repair mortar manufacturer.
- D. Epoxy Resin Adhesive
1. Use an appropriate Epoxy Resin Adhesive meeting AASHTO M 235.
 - a. Provide Type V for all applications.
 - b. Provide Grade 3 for all applications.
- E. Injection Adhesive
1. Use an injection adhesive meeting AASHTO M 235.
 - a. Use Type IV for all applications.
 - b. Meet the requirements for Grade 1 for cracks that can be surface sealed on all faces.
 - c. Meet the requirements for Grades 1, 2 or 3 for cracks that cannot be surface sealed on all faces.
- F. Surface Seal
1. Use a surface seal recommended by the injection adhesive manufacturer.
 2. Capable of containing injection adhesive in cracks during pressure injection and until the injection adhesive has cured.
- G. Reinforcing Steel
1. Coated reinforcing steel according to Section 03211.

2.2 EQUIPMENT REQUIREMENTS

- A. Concrete Repair Mortar Mixer
 - 1. Use a small mixer to batch out the concrete repair mortar.
- B. Epoxy Injection system
 - 1. Use at least two pumps having the following characteristics:
 - a. Electric-powered and portable
 - b. Positive displacement
 - c. Positive-ratio control of exact proportions of the two components at the nozzle
 - d. In-line metering and mixing
 - 2. Automatic pressure control capable of discharging the mixed adhesive at any preset pressure up to 200 psi $\pm$ 0.5 psi and equipped with a manual pressure control override.
 - 3. Capable of maintaining the volume ratio of the injection adhesive prescribed by the manufacturer within a tolerance of $\pm$ 5 percent by volume at any discharge pressure up to 200 psi.
 - 4. Sensors on both the component reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.
- C. Sandblaster
 - 1. Use a sandblaster that meets the requirements in ASTM D 4285.
- D. Jackhammer
 - 1. 30 lb class
 - 2. 15 lb class

PART 3 EXECUTION

3.1 PREPARATION FOR DELAMINATION REPAIR

- A. Locate the repair areas.
 - 1. Sound the items requiring this work and mark the limits of delaminated areas for repair work in the presence of the Engineer.
- B. Concrete removal
 - 1. Make ½ inch deep saw cuts in the sound concrete along the perimeter of the repair area

2. Remove damaged, shattered, and delaminated concrete.
 - a. Use 30 lb class jackhammer when allowed.
 - 1) Do not use pneumatic hammers heavier than 15 lb class for removals in areas directly below the top reinforcing steel.
 - 2) Use 15 lb class jackhammer or lighter for deck edge repair.
 - b. Operate jackhammer at an angle greater than 45 degrees as measured from the element surface.
 - c. Protect existing reinforcing steel encountered.
 - d. Replace or repair damaged reinforcing steel.
3. Remove loose materials by dry sweeping or clean and dry compressed air with at least 90 psi pressure. Refer to ASTM D 4285.
4. Sandblast clean exposed reinforcing steel and concrete surfaces before placing new concrete.
 - a. Protect in place sound rebar.
 - b. Prevent sandblasting material and debris from falling into waterways, pedestrian areas, traffic areas, or onto railroad tracks.
5. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
6. Replace existing reinforcing steel bars with 25 percent or greater section loss.
 - a. Cut and remove deteriorated existing reinforcing steel bars.
 - b. Match the size of the new reinforcing steel bar to the existing bar.
 - c. Provide lap lengths as shown.

3.2 EPOXY INJECTION

- A. General
 1. Pressure inject cracks 1/64 to 1/4 inch in width.
 2. Mark cracks to be pressure injected in the presence of the Engineer.
- B. Preparation
 1. Sandblast the concrete surfaces clean.
 2. Clean cracks of contaminants using oil-free compressed air according to ASTM D 4285.
 - a. Remove remaining material by flushing with water under pressure.

3. Space ports at a distance not more than the thickness of the concrete being injected.
 - a. Limit port spacing at ends of cracks to not more than half the concrete thickness.
 - b. Adjust port spacing based on manufacturer's recommendations and to ensure injection adhesive fills the cracks.
 4. Apply a surface seal over all exterior faces of the crack that can be reached to contain the injection adhesive in the crack.
- C. Epoxy Injection
1. Inject the crack when it is at its widest if the crack width changes because of daily temperature cycles or other structural loading of the structure,
 2. Proceed from lower to higher ports.
 3. Plug the port being injected and move to a higher port when injection adhesive appears at the next higher port.
- D. Final Surface Seal
1. Grind flush all ports extending above the concrete surfaces.
 2. Mask the member in parallel straight line segments between the ends of the crack so the surface seal has a clean and neat appearance when applied.
 3. Apply the surface seal at the application rate of at least 0.09 gal/yd².
 - a. Cover the entire length of the crack for at least 6 inches on both sides of the crack.
 4. Apply a second coat at the same application rate as soon as the first coat is dry to the touch.
 - a. Do not exceed the following times between coats:

Table 2

Maximum Time Between Coats	
Temperature (Degrees F)	Hours
66	72
77	36
90	24

3.3 DELAMINATION REPAIR

- A. Form Work
 - 1. Use forms and braces to place new concrete to the original dimensions.
 - a. Rebuild the areas to original shape, $\pm \frac{1}{8}$ inch.
 - 2. Vibration is required in the forms when the area between forms and existing concrete surface will allow use of vibrators.
- B. Repairs with a thickness less than or equal to three inches:
 - 1. Use concrete repair mortar.
 - 2. Coat the cleaned concrete using the substrate coating.
 - 3. Place concrete repair mortar in layers not exceeding the manufacturer's recommended application thickness per layer.
 - a. Rebuild the areas to original shape, $\pm \frac{1}{8}$ inch.
 - 4. Follow the manufacturer's recommendations for finishing and curing.
- C. Repairs with a thickness greater than three inches.
 - 1. Use concrete.
 - 2. Apply an epoxy resin adhesive to the cleaned concrete surface of the repair area before placing the new concrete.
 - 3. Place, form, and finish concrete and construct falsework according to Section 03310.
 - 4. Cure concrete according to Section 03390.
- D. Finished Surfaces – Provide the look of one color.

3.4 STRUCTURAL CONCRETE REPAIR

- A. Perform work according to Table 3.

TABLE 3

Structural Concrete Repair Items	
Item	Work Required
Column Repair	Preparation for delamination repair Epoxy injection Delamination repair
Pedestal Repair	Jack girders (when shown) Preparation for delamination repair Delamination repair
Bent Cap Repair	Jack girders (when shown) Preparation for delamination repair Epoxy injection Delamination repair
Diaphragm Repair	Preparation for delamination repair Epoxy injection Delamination repair
Wingwall Repair	Preparation for delamination repair Delamination repair
Abutment Backwall Repair	Preparation for delamination repair Delamination repair
Girder Repair	Preparation for delamination repair Epoxy injection Delamination repair
Girder End Repair	Jack girders (when shown) Preparation for delamination repair Epoxy injection Delamination repair
Parapet Repair	Preparation for delamination repair Delamination repair
Deck Edge Repair	Preparation for delamination repair Delamination repair
Structural Concrete Repair	Preparation for delamination repair Epoxy injection (when shown) Delamination repair
Crack Repair	Epoxy injection

- B. Remove sandblasting materials and debris from adjacent surfaces after the work is complete.

END OF SECTION

SECTION 03932

CONCRETE SLOPE PROTECTION REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete slope protection and cutoff wall.

1.2 RELATED SECTIONS

- A. Section 02721: Untreated Base Course (UTBC)
- B. Section 03055: Portland Cement Concrete
- C. Section 03152: Concrete Joint Control
- D. Section 03211: Reinforcing Steel and Welded Wire
- E. Section 03310: Structural Concrete
- F. Section 03390: Concrete Curing

1.3 REFERENCES

- A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- B. ASTM D 545: Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data and recommended installation instructions for all materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland Cement Concrete Class A(AE) – Refer to Section 03055.

- B. Reinforcing Steel and Welded Wire – Refer to Section 03211.
- C. Backer Rod
 - 1. Size the diameter of the backer rod to a minimum of $\frac{1}{4}$ inch larger than the joint opening.
 - 2. Use a closed cell foam expansion joint filler.
 - a. Meets the physical properties in Table 1 using test method ASTM D 545 utilizing a 2 inch backer rod specimen.

Table 1

Physical Property	Requirement
Density	2.0 lb/ft ³ , minimum
Tensile Strength	25 psi, minimum
Compression	5 psi at 25%, minimum
Water Absorption	0.03 g/cc by weight, minimum (1% maximum)
Temperature at 410°F	No Melting

- D. Rigid Plastic Foam – Refer to ASTM C 578.
 - 1. Type 9, Density of 2 lb/ft³.
- E. Joint Sealer (Structures) – Refer to Section 03152.
- F. Untreated Base Course – Refer to Section 02721.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare the subgrade of the area to be paved.
 - 1. Smooth and shape the berms and slopes. Excavate for cutoff walls where required.
 - 2. Fill depressions with Untreated Base Course material, grade, and compact.
 - 3. Firmly compact the subgrade for Type II Placement.
 - 4. Thoroughly wet the surface with water before placing the concrete.

3.2 PLACE RIGID PLASTIC FOAM

- A. Place rigid plastic foam material 1 inch thick against the surface of all structural members before placing the concrete slope protection.
- B. Anchor the rigid plastic foam in place with a compatible adhesive.

- C. Recess the rigid plastic foam in the joints against structural members so a groove is formed above the rigid plastic foam filler.

3.3 PLACE REINFORCING STEEL

- A. Place reinforcing steel or welded wire when as shown according to Section 03211.
- B. Install doweled anchors when as shown according to Section 03211.

3.4 PLACE CONCRETE

- A. Place concrete a maximum of 7 days after removing the existing concrete slope protection unless otherwise determined by the Engineer. Refer to Section 03310.
- B. Make concrete of a consistency so it can be placed on the slopes without deformation.
- C. Re-establish the original joint and scoring design unless shown otherwise..
- D. Place entire slope protection during one placement. Use a construction joint located in a scoring or at the junction of the slope and the abutment if it is not feasible to complete in a single placement.

3.5 FINISH AND CURE CONCRETE

- A. Use a Floated Surface Finish. Refer to Section 03310.
- B. Cure – Refer to Section 03390.

3.6 SEAL JOINTS AND CLOSURES

- A. Place the backing rod and Joint Sealer (Structures) when the concrete has properly cured.
 - 1. Completely remove curing compounds, oil, grease, dirt, and any other foreign materials from concrete surfaces in the joints by sandblasting.
 - 2. Provide concrete surfaces in the joints that are clean and dry when backing and sealant are placed.
 - 3. Place as shown.

- B. Place the sealant with caulking guns in joints after placing the backing rod and in the recess above the rigid plastic foam.
1. Place sealant when the ambient air temperature is at least 50 degrees F and rising.
 2. Start the sealant placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical joints.
 3. Tool the sealant using a concave pointing tool with soap solution until the joints and recess are sealed over completely.
 4. Finish sealant in a neat and clean fashion.
 - a. Verify there are no irregular surfaces including peaks and valleys.
 - b. Remove sealant outside of the joint.

END OF SECTION

SECTION 03933

PARAPET MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Modifying existing concrete parapet systems.
- B. Prepare the parapet system for attachment of guardrail system or precast concrete barrier.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03152: Concrete Joint Control
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 03310: Structural Concrete
- E. Section 03390: Concrete Curing
- F. Section 03924: Structural Concrete Repair

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types)
- C. AASHTO M 270: Structural Steel for Bridges
- D. ASTM A 780: Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- E. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- F. ASTM D 545: Performed Expansion Joint Fillers for Concrete Construction (Non-extruding and Resilient Types)

G. ASTM D 3963: Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars

H. ASTM D 4285: Indicating Oil or Water in Compressed Air

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data, specifications, and recommended installation instructions.
- B. Method of removal to the Engineer for review before removing concrete on the parapet.
 - 1. Include equipment, sequence of work, shoring, falsework, and other items that are required for the removal.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland Cement Concrete, Class AA(AE) – Refer to Section 03055.
- B. Reinforcing Steel (Coated) – Refer to Section 03211.
- C. Connection Bar
 - 1. Grade 36 – Refer to AASHTO M 270.
 - 2. Galvanized – Refer to AASHTO M 111.
- D. Guardrail Preset Anchors –As shown.
- E. Preformed Joint Filler – Refer to AASHTO M 213.
- F. Epoxy Resin Adhesive
 - 1. Use an appropriate Epoxy Resin Adhesive according to Section 03924.
- G. Rigid Plastic Foam
 - 1. Refer to ASTM C 578
 - 2. Type 9, density of 2 lb/cu ft.
- H. Backer Rod
 - 1. Size the diameter of the backer rod to a minimum of $\frac{1}{4}$ inch larger than the joint opening or as shown.
 - 2. Use a closed cell foam expansion joint filler.

- a. Meets the physical properties in Table 1 using test method ASTM D 545 utilizing a 2 inch backer rod specimen.

TABLE 1	
Physical Property	Requirement
Density	2.0 lb/ft ³
Tensile Strength	25 psi, minimum
Compression	5 psi at 25%, minimum
Water Absorption	0.03 g/cc by weight, minimum (1% maximum)
Temperature at 410°F	No Melting

- I. Joint Sealer (Structures) – Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

- A. Debris Containment
1. Prevent debris from falling into waterways, pedestrian areas, traffic areas, and onto railroad tracks.
- B. Locate existing electric conduit and protect from damage.
- C. Carefully remove existing parapet railing and brackets and deliver to the Department maintenance shed designated by the Engineer.

3.2 CONCRETE REMOVAL

- A. Parapet Modification
1. Remove the existing parapet concrete according to the authorized method. Prevent damage to wingwalls, deck surface, and existing rebar that will remain.
 2. Remove loose and spalled concrete.
 3. Sandblast clean all concrete surfaces before placing new concrete.
- B. Parapet End Modifications
1. Make saw cuts 1 inch deep to define the work area.
 2. Remove concrete using 90 pound class, hand-held jackhammers or smaller. Prevent damage to wingwall, deck, and existing rebar that will remain.
 3. Remove approach slab curb between the parapet end and the approach slab end.
 4. Remove loose and spalled concrete.
 5. Sandblast clean all concrete surfaces before placing new concrete.

3.3 REINFORCING STEEL

- A. Existing Reinforcing Steel
 - 1. Field cut and field bend as shown. Refer to Section 03211.
 - 2. Thoroughly clean by sandblasting remaining steel of all corrosion and adhering materials. Protect in place any sound rebar.
 - 3. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
 - 4. Repair the surface of damaged rebar before placing concrete.
 - a. Epoxy coating repair – Refer to ASTM D 3963.
 - b. Galvanized rebar repair – Refer to ASTM A 780.
- B. New Reinforcing Steel
 - 1. Install doweled anchors according to Section 03211 and as shown.
 - 2. Place new coated reinforcing steel after sandblasting operations are complete.

3.4 CONNECTION BARS

- A. Provide bars as shown for each parapet end modification and each parapet modification.

3.5 FORMS

- A. Refer to Section 3310.

3.6 PLACE CONCRETE

- A. Re-establish existing joint pattern unless an alternative joint pattern is shown.
 - 1. Place rigid plastic foam as shown.
- B. Clean concrete and steel surfaces. Dampen existing concrete before placing new concrete.
- C. Apply an epoxy resin adhesive to the repair area to assist in bonding the fresh concrete to the hardened concrete. Refer to Section 03924.
 - 1. Apply the material according to the manufacturer's specifications.
 - 2. Keep the repair area clean until new concrete has been placed.
- D. Refer to Sections 03055 and 03310.

3.7 FINISH AND CURE

- A. Refer to Section 03310 and 03390.

3.8 SEAL JOINTS

- A. Remove excess rigid plastic foam from joints to provide room to seal joints as shown.
- B. Clean the joint area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
- C. Place backer rod when required.
- D. Place Joint Sealer (Structures).
 - 1. Place sealant when the ambient air temperature is at least 50 degrees F and rising.
 - 2. Start the sealant placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical joints.
 - 3. Tool the sealant using a concave pointing tool with soap solution until the joints and recess are sealed over completely.
 - 4. Finish sealant in a neat and clean fashion.
 - a. Verify there are no irregular surfaces including peaks and valleys.
 - b. Remove sealant outside of the joint.

3.9 CLEAN UP

- A. Remove sandblasting materials and debris from the deck or approach slab after the work is complete.

END OF SECTION

SECTION 03934

STRUCTURAL POTHOLE PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Repair of potholes and delaminated areas on bridge decks and approach slabs.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete

1.3 REFERENCES

- A. ASTM C 928: Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- B. ASTM D 4285: Indicating Oil or Water in Compressed Air
- C. ASTM D 4580: Measuring Delaminations in Concrete Bridge Decks by Sounding

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.
- B. Structural Pothole Documentation for information
 - 1. Document the size, location, and repair material used in structural pothole repair area using the 11 x 17 inch plan sheet shown.

1.6 QUALITY CONTROL

- A. Manufacturer's Technical Representative
 - 1. Provide a technical representative from the structural pothole patching product manufacturer for training and consultation.
 - a. Provide training in surface preparation, proper mixing, placing and finishing technique, safety precautions, traffic opening time, and environmental requirements.
 - 1) Train workers who will mix, place, or finish the structural pothole patching product during production work in a pre-production meeting.
 - 2) Use a mockup to demonstrate proper mixing, placing, and finishing technique.
 - 3) Coordinate training with the Engineer.
 - b. The manufacturer's technical representative must:
 - 1) Be onsite during surface preparation and application of the structural pothole patching product on the initial structure and for the first day the structural pothole patching product is used on the project.
 - 2) Be available for consultation but not necessarily present at the job site for the remaining work.
 - 3) Be available to train workers who did not attend the preproduction training before they can perform production work.
 - 2. Do not use workers for the production work who have not been trained by the manufacturer's technical representative.
 - 3. The Engineer may waive the requirement for the manufacturer's technical representative to be onsite if the Contractor can demonstrate that the superintendent for the work has performed at least five satisfactory applications of the structural pothole patching product on similar bridges in similar environments.
 - a. The manufacturer's technical representative must be available for consultation throughout the duration of the application.
 - 4. The Department reserves the right to require the manufacturer's technical representative to be onsite if at any time the Engineer is concerned with the product installation quality.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete – Class AA(LS), ¾ inch maximum aggregate. Refer to Section 03055.
- B. Rapid Setting Repair Mortar – Refer to ASTM C 928.
 - 1. Provide Type R3.
 - 2. Provide patch materials free of magnesium phosphate.
- C. Reinforcing Steel
 - 1. Coated reinforcing steel according to Section 03211.
- D. Water – Use potable water free from harmful salts, reactive chemicals, and other contaminants.

2.2 EQUIPMENT

- A. Jackhammer
 - 1. 30 lb class
 - 2. 15 lb class
- B. Pressure Washer
 - 1. Minimum 3000 psi and a maximum of 7000 psi

PART 3 EXECUTION

3.1 PREPARATION

- A. Locate unsound concrete in the deck and approach slabs and mark a rectangular area surrounding each pothole as shown. Refer to ASTM D4580.
 - 1. Remove asphalt surfacing before conducting sounding survey.

3.2 CONCRETE REMOVAL

- A. Use either the jackhammer or hydro-demolition method described below.
 - 1. Jackhammer Method
 - a. Saw Cuts – Make 1 inch deep saw cuts in the sound concrete along the rectangular perimeter of the repair areas.
 - 1) Stop saw cuts and notify the Engineer if reinforcing steel is encountered.

- 2) Replace reinforcing steel that has been cut during this operation having a cut depth equal to or greater than 25 percent of the diameter of the reinforcing steel.
 - a) Provide lap lengths of the new reinforcing steel with sound existing reinforcing steel at least of 32 bar diameters..
 - b. Remove damaged, shattered, and delaminated concrete.
 - 1) Use 30 lb class jackhammer.
 - a) Do not use pneumatic hammers heavier than 15 lb class for removals in areas directly below the top reinforcing steel.
 - c. Operate jackhammer at an angle greater than 45 degrees as measured from the element surface.
 - d. Remove the concrete to ½ inch below the bottom of top mat of reinforcing steel if the delamination occurs at the depth of the top mat of reinforcing steel.
 - e. Protect existing reinforcing steel encountered.
 - f. Replace or repair damaged reinforcing steel.
 2. Hydro-demolition Method
 - a. Obtain the most current requirements for hydro-demolition from the Department.
- B. Remove loose materials by dry sweeping or by compressed air with at least 90 psi pressure. Refer to ASTM D 4285.
- C. Deck Blow Through
 1. Immediately stop the equipment and notify the Engineer and make the necessary adjustments to limit the area of complete concrete removal if removal blows completely through the bridge deck.
 2. Provide appropriate falsework and formwork to support construction loads safely.
 3. Use treated plywood to facilitate stripping.
- D. Replace existing reinforcing steel that have 25 percent or greater section loss.
 1. Cut and remove deteriorated existing reinforcing steel.
 2. Match the size of the new reinforcing steel bar to the existing bar.
 3. Provide lap lengths of the new reinforcing steel with sound existing reinforcing steel at least of 32 bar diameters.
- E. Keep the repair area clean until new concrete has been placed.

3.3 BONDING CONCRETE

- A. Follow manufacturer's recommendations when using rapid setting repair mortar.

3.4 PATCHING CONCRETE

- A. Sandblast clean the exposed reinforcing steel and concrete surfaces before placing the structural pothole patch.
 - 1. Protect in-place any sound reinforcing steel.
 - 2. Re-sandblast reinforcing steel if rust occurs before placement.
- B. Clean the repair area by blowing with clean and dry compressed air at 90 psi. Refer to ASTM D 4285.
- C. Pressure wash the repair area.
 - 1. Remove standing water while maintaining a saturated surface.
 - 2. Repeat pressure washing of the repair area before placing the structural pothole patch if the repair surface shows signs of drying out.
- D. Repairs using concrete
 - 1. Place concrete and strike off level with deck surface. Refer to Section 03310.
 - 2. Finish surface of bridge deck and approach slab according to Section 03310.
 - 3. Apply a liquid membrane-curing compound and wet cure the repair area for at least 7 days and until the concrete repair has a compressive strength of at least 3500 psi.
- E. Repairs using rapid setting repair mortar
 - 1. Follow the manufacturer's requirements for placing, finishing, and curing if using rapid setting repair mortar.
 - 2. Use a texture process that produces regular $\frac{1}{8}$ inch wide transverse grooves spaced randomly from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch on centers and $\frac{1}{8}$ inch deep.
- F. Patch failure – Remove the patch completely and repair the pothole again if the patch fails to bond to the existing concrete.

3.5 PROTECTION

- A. Prevent debris from falling into waterways, pedestrian areas, traffic areas, or onto railroad tracks.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural steel for bridges and structures.

1.2 RELATED SECTIONS

- A. Section 05822: Bearings
- B. Section 09972: Painting for Structural Steel

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 270: Structural Steel for Bridges
- C. AASHTO LRFD Bridge Construction Specifications
- D. AASHTO LRFD Bridge Design Specifications
- E. AASHTO/AWS D1.5 Bridge Welding Code
- F. ASTM A 194: Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- G. ASTM A 370: Mechanical Testing of Steel Products
- H. ASTM A 563: Carbon and Alloy Steel Nuts
- I. ASTM F 436: Hardened Steel Washers
- J. ASTM F 606: Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
- K. ASTM F 959: Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

- L. ASTM F 3125: High Strength Structural Bolts, Steel and alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength
- M. American Institute of Steel Construction (AISC)
- N. Research Council on Structural Connections (RCSC)
- O. Society for Protective Coatings (SSPC)
- P. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS

- A. Main Members – Members on a critical load path that carry bridge dead and live loads. The loss of capacity of main members would have serious consequences on the structural integrity.
- B. Secondary Members – Members other than main members, not designed to carry primary load.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of all fabricated materials for review.
 - a. The seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) is not required.
 - 2. Erection Drawings for all structural steel members for review.
 - a. Fully illustrate the proposed method of erection. Provide complete details of the process including, but not limited to:
 - 1) Temporary supports, bracing, guys, dead-men, lifting devices, connection details and attachments to bridge members.
 - 2) The schedule and sequence of erection, location of cranes, crane capacities, location of lifting points on the bridge members, member weights, and any other assumed loads.
 - 3) Complete details for all anticipated phases and conditions during erection.
 - 4) Minimum number of items such as main members, secondary members, and connections that must be installed and properly connected to provide structural integrity and stability.

- 5) Supporting calculations according to the current edition of the AASHTO LRFD Bridge Design Specifications to demonstrate that factored member capacities are not exceeded and final geometry will be correct.
- 6) Incorporate into the erection drawings the requirements from this Section, article 3.5.
- 7) Bolting Procedure for field splices and diaphragms that meets the RCSC Specifications for Structural Joints Using High-Strength Bolts including at least the following:
 - a) Handling, storage and identification of fasteners.
 - b) Preparation of bolted parts.
 - c) Pre-installation verification.
 - d) Installation.
 - e) Inspection.
 - f) Personnel or positions responsible for each activity
- b. Include supporting engineering calculations.
- c. Provide the seal of a PE or SE licensed in the State of Utah on the drawings and calculations.
3. Drawings for temporary works.

B. Material Submittals

1. Manufacturer's certificate of compliance for bolts, nuts, and washers.
 - a. Refer to ASTM F 606 and ASTM F 3125.
 - b. Include corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of the testing.
 - c. Include rotational capacity and proof load test results.
2. Three complete fastener assemblies of each combination of diameter, length, grade and lot for verification testing.
3. Certified mill test reports (MTR) for all fabricated structure materials, seven calendar days before fabrication, including materials manufactured outside of the United States. Clearly indicate country of origin on MTR.
4. Charpy V-Notch test results for information. Refer to ASTM A 370.

C. Welding Submittals

1. Weld Procedure Specifications and Procedure Qualification Records as required by the specified AWS Code.

- 2. Welder test reports for each operator, process, and position as required by the specified AWS Code.
 - a. A letter from the Fabricator that states the certified welders have been using the process without an interruption of more than six months since being certified.
- D. Documentation of AISC Certification for information.
 - 1. Fabrication certification according to this Section, Article 2.6.
- E. Bolted Field Splice Certification and Bolted Diaphragm Certification forms.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Follow AASHTO LRFD Bridge Construction Specifications, Article 11.3, unless otherwise indicated.
- B. Do not use stock steel purchased from a warehouse for use in a main member without conducting mill inspection, unless authorization is given.

2.2 HIGH STRENGTH FASTENERS

- A. Use bolts, nuts, and washers displaying the manufacturer's markings.
- B. Bolts
 - 1. Refer to ASTM F 3125. Use Grade A325, Heavy Hex Head.
- C. Nuts
 - 1. Refer to ASTM A 194 or ASTM A 563.1. Use heat-treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are shown.
- D. Washers
 - 1. Refer to ASTM F 436.
- E. Direct Tension Indicator (DTI) Washers
 - 1. Refer to ASTM F 959.
- F. Certification of Bolts and Nuts (Black, Weathering and Galvanized)
 - 1. Subject to applicable tests from ASTM F 3125 Table 3, with the following clarifications:
 - a. Wedge test bolts and nuts according to ASTM F 3125 Section 10.1.

- b. Proof load test bolts and nuts according to ASTM F 606 Method 1.
- c. Tests for rotational capacity of bolts and nuts according to ASTM F 3125 Supplemental S4 and Annex A2.

2.3 ELASTOMERIC BEARINGS AND ANCHORAGES

- A. Refer to Section 05822.

2.4 APPROACH SLAB DRAIN ANGLES AND GRATES

- A. Refer to AASHTO M 270, Grade 36, or as shown.
- B. Hot-dip galvanize after fabrication. Refer to AASHTO M 111.

2.5 SHOP INSPECTION

- A. Notify Engineer immediately upon placing the fabrication order to allow time for shop inspection.
 - 1. In-state work requires 7 days advanced notice; out-of-state work requires 30 days advanced notice.
 - 2. Schedule shop inspection before beginning fabrication.
 - 3. Facilitate inspection procedures on site and supply adequate personnel to perform quality control.

2.6 FABRICATION

- A. Fabricate according to AASHTO LRFD Bridge Construction Specifications Section 11, UDOT Steel and Concrete Construction Manual, and AASHTO/AWS D 1.5.
- B. The fabricator must have AISC Certified Bridge Fabricator – Advanced Certification (ABR) if fabricated structural steel will be part of a bridge structure except as follows:
 - 1. Railings, grates, grate frames, and drain pipes may be fabricated with AISC Bridge Component Certification (CPT).
- C. Surface preparation of steel
 - 1. Painted Steel
 - a. Refer to Section 09972.
 - 2. Unpainted Weathering Steel
 - a. Meet sandblaster qualifications and surface preparation requirements for painted steel according to Section 09972.
 - b. Construct so that erection marks on the steel are not visible after the structure is completed.

- c. Commercially blast the following surfaces according to SSPC-SP 10:
 - 1) I-girders
 - a) Underside of the exterior portion of the top flange of fascia girders and underside of bottom flange of all girders.
 - b) Exterior portion of web of fascia girders.
 - c) Top side and outside edge of the exterior portion of the bottom flange of fascia girders.
 - d) All welded surfaces.
 - 2) Trusses
 - a) Top chord, diagonals, and top bracing.
 - b) Exposed surfaces of bottom chord, floor beams, and bottom bracing.
 - c) All welded surfaces.
- d. Commercially blast all other surfaces according to at least SSPC-SP 6.
- e. Develop even patina at completion of welding repair and after surface has been verified by the Engineer.

PART 3 EXECUTION

3.1 INSTALL HIGH STRENGTH FASTENERS

- A. Store the bolts and nuts in the original containers until used.
 - 1. Protect from dirt and moisture.
 - 2. Remove only as many fasteners from protected storage as can be tightened during a work shift.
 - a. Return unused fasteners to protected storage at the end of each work shift.
 - 3. Clean and re-lubricate fasteners that accumulate rust or dirt resulting from site conditions.
 - a. Use manufacturer's recommended lubricant.
- B. Testing
 - 1. Test the installed bolt, nut, and washer assembly before beginning erection and periodically to verify compliance.
 - 2. Provide a Skidmore-Wilhelm Calibrator or other acceptable bolt tension indicating device for bolt testing at the job site.
 - 3. Check the DTI washers in a Skidmore-Wilhelm Calibrator using bolts of sufficient length.
 - a. Use DTI washers with solid plates when the fastener-grip length is too short to be tested in a Skidmore-Wilhelm Calibrator.

- C. Install fasteners according to AASHTO LRFD Bridge Construction Specifications, Section 11.5.6.4, the bolting procedure in the authorized erection drawings, and the following:
1. Complete the Bolted Field Splice Certification form at the end of this Section as fastener tightening progresses for all girder field splices.
 2. Complete the Bolted Diaphragm and Cross Frame Member Certification form at the end of this Section.
 3. Use DTI washers to indicate bolt tension.
 - a. Follow the manufacturer's methods and procedures as modified by the Engineer.
 - b. Place DTI washer on the side of the connection that will not be embedded in concrete.
 - 1) A DTI washer is still required if the entire fastener will be embedded in concrete.
 - 2) Do not place concrete until the inspector has certified that all fasteners are properly tightened.
 4. Use drift pins to align bolt holes and maintain dimensions and camber of the member.
 5. Insert bolts in open holes with washers and hand tighten.
 6. Tighten at least 50 percent of the fasteners as required to approximately one-half final tension to draw all plies of the connection into firm contact.
 - a. Do not tighten any fasteners to indicated full tension at this time.
 7. Remove drift pins and replace with bolts.
 8. Tighten fasteners progressively from fixed or rigid points to the free edges.
 9. Fully tighten 50 percent of the fasteners for field splices and diaphragms. Verify remaining fasteners are snug tight before release of crane or removal of shoring.
 - a. Reduce the DTI washer gap to 0.005 inch regardless of which element is turned for tightening.
 10. Tighten all fasteners to full tension.
 11. Review the DTI washer compression for each fastener after the first connection.
 - a. Re-evaluate tightening procedure and make corrections as required if over 50 percent of DTI washers tested are fully compressed.

3.2 FIELD WELDING

- A. Weld according to AASHTO/AWS D1.5.
- B. Meet the same requirements as shop welds.

- C. Comply with welding procedures and inspection requirements.
 - 1. Refer to UDOT Steel and Concrete Construction Manual.
- D. Welding operators must be certified according to the specified AWS Code.
 - 1. Refer to UDOT Steel and Concrete Construction Manual.

3.3 PAINTED STRUCTURAL STEEL

- A. Paint all structural steel not designated as unpainted weathering steel.
 - 1. Refer to Section 09972.

3.4 UNPAINTED WEATHERING STEEL

- A. Clean girders of debris after deck concrete is placed.
 - 1. Redevelop patina as needed.

3.5 ERECTION

- A. Erector Qualifications
 - 1. An AISC certified erector with one of the following certifications is preferred when erecting, bolting, and welding bridge framing members:
 - a. Certified Steel Erector with Bridge Erection Endorsement (requirements criteria),
 - b. Advanced Certified Steel Erector (checklist criteria).
- B. Maintain responsibility for girder erection during each stage of construction including the protection of structural steel members, the workers, and the traveling public.
- C. Erect structural steel members according to the authorized erection drawings and in a manner that prevents damage to elements of the structure.
 - 1. Follow match-marks.
- D. Temporarily support, anchor, and brace main members such as girders during erection to produce the proper alignment and camber in the completed structure.
 - 1. Install cross frames and diagonal bracing as necessary to provide stability and correct geometry.
 - 2. Provide temporary bracing or stiffening devices if necessary during each erection stage.
 - 3. Support, anchor, and brace erected superstructure members as detailed in the authorized erection drawings before allowing traffic under the bridge.

- E. Design temporary supports and falsework according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3, Temporary Works.
- F. Provide additional materials that are required to keep both the temporary and final stresses within the allowable limits used in design.
- G. Handle materials so that no parts will be bent, broken, or otherwise damaged.
 - 1. Do not injure or distort the members when hammering.
- H. Remove dirt and debris from bearing surfaces and surfaces that will be in permanent contact before the members are assembled.
- I. Do not open traffic under a partially erected bridge superstructure unless allowed in the authorized erection drawings.

END OF SECTION

Bolted Field Splice Certification and Bolted Diaphragm Connection Certification forms follow.

Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of splices. Copy this page as required. Initial the appropriate box to certify that the fastener tightening has been completed according to the specifications.

Do not perform final tightening until the inspector certifies that plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all fasteners are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

Project Number:

Structure Number:

Splice No.	Top Flange		Web		Bottom Flange	
Plates were drawn into contact with each other before final tightening of fasteners.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Fasteners are tightened to spec. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

Splice No.	Top Flange		Web		Bottom Flange	
Plates were drawn into contact with each other before final tightening of fasteners.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Fasteners are tightened to spec. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

Splice No.	Top Flange		Web		Bottom Flange	
Plates were drawn into contact with each other before final tightening of fasteners.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Fasteners are tightened to spec. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials

Bolted Diaphragm and Cross Frame Member Connection Certification

Consecutively number diaphragm connections looking stations ahead and increasing from left to right. Number across the beam lines before moving down station to the next line of connections. Copy this page as required. Initial the appropriate box to certify that the fastener tightening has been completed according to the specifications.

Do not perform final tightening until the inspector certifies that connection plates are drawn into full contact. Do not place concrete deck until the inspector has certified that all fasteners are properly tightened.

Send a completed copy of this form to the Engineer before the final inspection.

Project Number:

Structure Number:

Connection No.		
Plates were drawn into contact with each other before final tightening of fasteners.	Contractor Initials	Inspector Initials
Fasteners are tightened to specification. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials

Connection No.		
Plates were drawn into contact with each other before final tightening of fasteners.	Contractor Initials	Inspector Initials
Fasteners are tightened to specification. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials

Connection No.		
Plates were drawn into contact with each other before final tightening of fasteners.	Contractor Initials	Inspector Initials
Fasteners are tightened to specification. Gap under direct tension indicator is less than or equal to 0.005 inch.	Contractor Initials	Inspector Initials

SECTION 05121

STRUCTURAL PLATE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural plate pipe structures.
- B. Cast-in-place concrete elements including footings, cutoff walls, reinforced concrete slope collars, thrust blocks, and headwalls as shown.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02075: Geotextiles
- C. Section 02317: Structural Excavation
- D. Section 03055: Portland Cement Concrete
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 03310: Structural Concrete

1.3 REFERENCES

- A. AASHTO M 167: Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
- B. AASHTO M 219: Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
- C. AASHTO M 243: Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
- D. AASHTO LRFD Bridge Construction Specifications
- E. AASHTO LRFD Bridge Design Specifications
- F. AASHTO Manual for Bridge Evaluation

G. UDOT Bridge Management Manual

1.4 DEFINITIONS

A. Deflection – A deviation from a pipe's original shape.

1.5 SUBMITTALS

A. Manufacturer's certificate of compliance for fabricated structure materials. Refer to AASHTO M 167 and AASHTO M 219.

B. Working Drawings

1. Fabrication and installation drawings for review of fabricated materials, and cast-in-place elements that are included in this item of work and are not detailed in the contract plans.
 - a. Include details not provided in the contract documents for the fabrication, transportation, erection, and construction of the members included in this item of work.
 - 1) Meet the requirements for Structural Plate Pipes according to AASHTO LRFD Bridge Construction Specifications, Section 26.
 - b. Include bedding and backfill requirements that exceed the requirements shown.
 - c. Manufacturer's installation instructions and incidental materials required for installation.
 - d. Detail all construction phases including layout, joint details, position of each plate, assembly order, casting methods, construction placement, and details of cast-in-place elements included in this item of work.
 - e. Load Rating Report and supplemental documentation according to the AASHTO Manual for Bridge Evaluation and the UDOT Bridge Management Manual for spans greater than 20 ft.
 - f. Include inventory and operating load ratings in a table on the first sheet of the drawings for spans greater than 20 ft.
 - 1) Measure span length along roadway centerline.

- g. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah on the drawings and supporting engineering calculations for the following:
 - 1) Designs of structural plate pipe structures.
 - 2) Structural members and ancillary appurtenances designed by the fabricator.
 - 3) Connections to cast-in-place members and appurtenances.
 - 4) Load ratings.
 - 5) Other means and methods that require an engineer's design.

PART 2 PRODUCTS

2.1 BEDDING

- A. Granular Backfill Borrow – Refer to Section 02056 and as shown.

2.2 STABILIZATION GEOTEXTILE

- A. Refer to Section 02075 and as shown.

2.3 BACKFILL

- A. Granular Borrow – Refer to Section 02056 and as shown.
- B. Granular Backfill Borrow – Refer to Section 02056 and as shown.

2.4 CONCRETE

- A. Use Class AA(AE) concrete according to Section 03055.

2.5 REINFORCING STEEL

- A. Use coated reinforcing steel according to Section 03211.

2.6 STEEL STRUCTURAL PLATE

- A. Corrugated Steel Structural Plate – Refer to AASHTO M 167.
- B. Corrugated Aluminum Alloy Structural Plate – Refer to AASHTO M 219.

2.7 NUTS AND BOLTS

- A. Refer to authorized fabrication and installation drawings.

2.8 FABRICATION

- A. Design structural plate pipe structures and cast-in-place concrete elements for all applicable loads according to AASHTO LRFD Bridge Design Specifications.
 - 1. Design structures for HL-93 vehicular live loading.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and Preparation
 - 1. Refer to Section 02317.
 - 2. Keep trenches free from water.
 - 3. Prepare foundation to provide a firm and uniform bearing throughout the entire length of the structure.
 - a. Scarify and compact the top 8 inches of the excavated ground surface to at least 90 percent of the maximum laboratory density.
 - 4. Place bedding according to the authorized fabrication and installation drawings.
- B. Assembly
 - 1. Assemble structural plate pipe structures according to the authorized fabrication and installation drawings.
 - 2. Provide loose-bolt assembly to maintain structure shape during erection unless temporary bracing is required.
 - a. Properly align plates to avoid permanent deflection from the design shape before bolt tightening.
 - 3. Install temporary bracing to maintain structure shape during erection when required.
 - a. Remove temporary bracing when backfilling reaches the top quadrant of the structure.
 - 4. Do not exceed the manufacturer's assembly tolerances before backfilling.
- C. Backfill
 - 1. Backfill structure according to the authorized fabrication and installation drawings.

2. Check and control the deflection of the structure during the entire backfilling operation.
 - a. Do not exceed the manufacturer's recommended limits.
- D. Cast-In-Place Concrete
 1. Place footings, cutoff walls, reinforced concrete slope collars, thrust blocks, and headwalls as shown.
 - a. Refer to Section 03310.
 - b. Clean bonding surfaces between elements of debris, dust, and rust before connecting elements.
 - c. Spray or brush-coat aluminum pipe in permanent contact with concrete with asphalt mastic to a minimum thickness of 0.05 inches.
 - 1) Refer to AASHTO M 243.
 2. Cast the Department structure number into the exposed faces of the reinforced concrete slope collar or headwall at each end of the structure as shown.

END OF SECTION

SECTION 05125

PREFABRICATED STEEL TRUSS BRIDGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prefabricated, steel truss bridge including bridge bearings, decking and anchorages.

1.2 RELATED SECTIONS

- A. Section 02821: Chain Link Fencing and Gates
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 05120: Structural Steel
- E. Section 05822: Bearings
- F. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

- A. AASHTO M 270: Structural Steel for Bridges
- B. AASHTO LRFD Bridge Design Specifications
- C. AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges
- D. AASHTO Guide Specifications for LRFD Seismic Bridge Design
- E. AWS D1.1 Structural Welding Code
- F. American Institute of Steel Construction (AISC)
- G. UDOT Quality Control/Quality Assurance (QC/QA) Procedures
- H. UDOT Structures Design and Detailing Manual (SDDM)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed Shop Drawings of fabricated materials (in addition to requirements in Section 05120).
 - a. Designate Charpy V-notch requirements.
 - b. Include design calculations for each truss bridge and bridge deck.
 - 1) Certify that the design has been checked according to the UDOT Quality Control/Quality Assurance (QC/QA) Procedures.
 - c. Include geometry verification stating that the dimensions, elevations, and layout of the truss are consistent with the substructure shown. Provide necessary changes.
 - d. Include anchor bolt requirements.
 - e. The seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) is required on shop drawings and calculations.
- B. Documentation for AISC Certification for information.

1.6 MANUFACTURER EXPERIENCE

- A. Minimum of five years experience designing and manufacturing welded prefabricated steel truss bridges for pedestrian and vehicle loads.
- B. AISC Certified Bridge Fabricator – Intermediate Certification (IBR).

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

- A. Refer to Section 05120.
 - 1. Stock steel purchased from a warehouse can be used in the fabrication of prefabricated steel truss bridges.

2.2 HIGH TENSILE STRENGTH BOLTS, NUTS, AND WASHERS

- A. Refer to Section 05120.

2.3 ELASTOMERIC BEARINGS AND ANCHORAGES

- A. Refer to Section 05822.

2.4 TIMBER DECKING

- A. Treated, Structural Timber and Lumber. Refer to Section 06055.
- B. S4S, Heart Center (HC), Douglas Fir, Grade No. 2 or better.
- C. Use only as shown.

2.5 CONCRETE

- A. Class AA (AE). Refer to Section 03055.

2.6 REINFORCING STEEL AND WELDED WIRE

- A. Use coated reinforcing steel. Refer to Section 03211.

2.7 CHAIN LINK FENCE

- A. Refer to Section 02821.

2.8 DESIGN

- A. Design prefabricated steel truss bridge and deck according to current editions of the AASHTO LRFD Bridge Design Specifications, the AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, the AASHTO Guide Specifications for LRFD Seismic Bridge Design and the SDDM.
 - 1. Design and detail the bridge to accommodate a 'Cold Climate' temperature differential.
 - 2. Provide at least 6 inch thick concrete deck.
 - 3. Use shear studs that extend at least to the center of the deck.
 - 4. Provide at least 2 inch clear cover to the top mat of reinforcing steel and to shear studs.
 - 5. Fracture critical requirements are waived except for Charpy V-notch testing.
 - a) Meet AASHTO M 270 zone 2 Charpy V-notch fracture critical requirements for main tension members.
- B. Verify that the clear span, clear width, elevations, and geometry shown are consistent with the truss bridge to be used at the site.
- C. Use two parallel trusses with at least one diagonal in each panel consistent with the layout, clear width, and span shown.
 - 1. The trusses must be main load-carrying members of the bridge.

2. Orient vertical truss members so they appear perpendicular to the bridge profile grade after the bridge is erected and dead loads are applied.
 3. Use square and rectangular structural tubing for the members of each truss (upper and lower chords, diagonals, end posts, and vertical posts).
- D. Use structural steel shapes or square and rectangular structural steel tubing for the floor beams and stringers.
- E. Provide structural steel thickness of at least $\frac{3}{8}$ inch.
- F. Provide drilled $\frac{1}{2}$ inch diameter weep holes at the low points of steel tubing members as oriented in the in-place, completed structure.
1. Flame cut holes are prohibited.
 2. Provide one weep hole at each end in members that are level or flat.

2.9 FABRICATION

- A. The following supplements the requirements in Section 05120:
1. Fabricate welded tubular connections according to AWS D1.1.
 - a. Meet the AASHTO M 270 zone 2 Charpy V-notch requirements for fracture critical members for main tension members.
 2. Timber Decking
 - a. Pre-drill timber deck for connections to floor beams.
 - b. Smooth exposed edges with $\frac{1}{8}$ inch radius.

PART 3	EXECUTION	Not Used

END OF SECTION

SECTION 05822

ELASTOMERIC BEARINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Plain elastomeric bearing pads.
- B. Steel reinforced elastomeric bearings with or without sliding surfaces.
- C. Components of elastomeric bearings such as masonry, sole and shim plates, anchor bolts, guide devices, polytetrafluoroethylene (PTFE) surfacing, and adhesive.

1.2 RELATED SECTIONS

- A. Section 05120: Structural Steel
- B. Section 09972: Painting for Structural Steel

1.3 REFERENCES

- A. AASHTO M 251: Plain and Laminated Elastomeric Bridge Bearings
- B. AASHTO M 270: Structural Steel for Bridges
- C. AASHTO LRFD Bridge Design Specifications
- D. AASHTO LRFD Bridge Construction Specifications
- E. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- F. ASTM A 240: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- G. ASTM D 6412: Epoxy (Flexible) Adhesive for Bonding Metallic and Nonmetallic Materials
- H. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- I. AWS D1.6: Structural Welding Code – Stainless Steel
- J. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

A. Working Drawings

1. Detailed shop drawings of all fabricated materials for review.
 - a. Include at least the following, as applicable:
 - 1) Total quantity of each type of bearing.
 - 2) Plan view and section elevation showing relative dimensions of each type of bearing.
 - 3) The maximum design coefficient of friction for sliding surfaces, when applicable.
 - 4) Materials for bearing elements.
 - 5) Welding details for welding process used in bearing manufacture.
 - 6) Vertical and horizontal load, rotation and movement capacity.
 - 7) Painting or coating requirements.
 - 8) Anchorage details.
 - 9) Location of fabrication plant.
 - 10) Manufacturer's name and name of the representative responsible for coordinating production, inspection, sampling and testing.
2. Drawings for temporary works.
 - a. Jacking Drawings for replacement elastomeric bearings for review when applicable.
 - 1) Include:
 - a) Jack locations.
 - b) Jacking sequence.
 - c) Jack technical data.
 - d) Temporary shoring.
 - e) Bridge lift dimension and required jack extension.
 - f) Dead loads and live loads.
 - 2) Provide supporting calculations with design to the AASHTO LRFD Bridge Design Specifications, including at least the following:
 - a) Jacked bridge element analysis, such as diaphragm (member and local) and girder (local) analysis as applicable.
 - b) Jack supporting element analysis, such as concrete bearing strength and falsework analysis as applicable.
 - c) Temporary shoring.

- B. Materials
 - 1. Certified mill test reports (MTR) for all fabricated steel materials for information.
 - 2. Manufacturer's certificate of compliance for Polytetrafluoroethylene (PTFE) coefficient of friction as specified in this Section and AASHTO LRFD Bridge Construction Specifications, Article 18.1.5.2.3.
 - a. Show corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of all testing.
- C. Welding
 - 1. Refer to Section 05120.
- D. Documentation of AISC Certification for information.
 - 1. Refer to this Section, Article 2.8.

PART 2 PRODUCTS

2.1 ELASTOMERIC BEARING PAD

- A. Refer to AASHTO LRFD Bridge Construction Specifications, Section 18.
- B. Place so markings are visible.

2.2 STEEL LAMINATE

- A. AASHTO M 251.

2.3 STRUCTURAL STEEL

- A. AASHTO M 270, Grade 36.
 - 1. Paint non-weathering steel according to Section 09972.

2.4 POLYTETRAFLUOROETHYLENE (PTFE)

- A. Refer to AASHTO LRFD Bridge Construction Specifications, Section 18.
- B. Use material composed of either filled or unfilled virgin PTFE sheets.
- C. Limit PTFE sheets to a thickness of at least 0.25 inch when maximum dimension of PTFE is greater than 24 inches, otherwise thickness of PTFE sheets is at least 0.1875 inches.

2.5 ADHESIVE

- A. ASTM D 6412.

2.6 STAINLESS STEEL PLATE

- A. ASTM A 240, Type 304.
- B. Limit thickness to at least $\frac{1}{8}$ inch.
- C. Provide a mirror-like finish of 8 micro inch or less (root mean square) on the side that contacts the PTFE.

2.7 ANCHOR BOLTS

- A. ASTM F 1554, Grade 36, 55, or 105-ksi.
 - 1. Galvanize according to ASTM A 153.

2.8 MANUFACTURE

- A. Fabricate according to AASHTO LRFD Bridge Construction Specifications, Section 18.1.4 and AASHTO M 251.
 - 1. AISC Highway Metal Components Certification (CPT) is required for fabrication of metal bearing components.
- B. Elastomeric bearings with sliding surfaces.
 - 1. Recess and bond PTFE to top plate at manufacturer's facility.
 - a. Recess at least one-half of PTFE thickness.
 - b. Do not bond the PTFE to the stainless steel sliding plate.
 - c. Make the bonded PTFE surface smooth and free from bubbles.
 - d. Polish the filled PTFE surfaces.
 - 2. Weld the stainless steel with $\frac{1}{8}$ inch continuous fillet welds to the sole plate.
 - a. Use a single piece of stainless steel.
 - b. Do not allow the weld metal to project beyond the plane of the sliding surface.
 - c. Use welding procedures compatible with the stainless steel specified.
 - 1) Refer to AWS D1.6 Structural Welding Code – Stainless Steel.
 - d. Stainless steel sheet must be flat, free from wrinkles, and in continuous contact with the sole plate after welding.

3. Protect stainless steel and PTFE sliding surfaces during manufacture, shipment, and erection.
 - a. Clean the sliding surfaces immediately before setting the girder in place.
 - b. The Department considers the unit damaged when the sliding surfaces are damaged by scratches, weld splatter, gouges, overspray from painting, and other defects.
4. Do not exceed coefficient of friction shown.

2.9 TESTING

- A. Test according to AASHTO LRFD Bridge Construction Specifications and AASHTO M 251.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Do not place structural steel bearing plates on bridge seat bearing areas that are improperly finished, deformed, or irregular.
 1. Set bearing plates level in exact position with full even bearing.
- B. Place elastomeric bearings so that the identification markings are visible after completion of the bridge.
- C. Do not subject the elastomer or its bond to temperatures higher than 250 degrees F.

3.2 ELASTOMERIC BEARINGS WITHOUT SLIDING SURFACES

- A. Install according to AASHTO LRFD Bridge Construction Specifications, Articles 18.1.7 and 18.2.6.

3.3 ELASTOMERIC BEARINGS WITH SLIDING SURFACES

- A. Install according to AASHTO LRFD Bridge Construction Specifications, Article 18.1.7.

3.4 REPLACEMENT ELASTOMERIC BEARINGS

- A. Remove existing bearings as shown.
 1. Provide jacking.
 2. Provide temporary shoring.

END OF SECTION

SECTION 05829

POURABLE JOINT SEAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pourable joint seal for sealing concrete expansion joints in bridge decks and approach slabs between:
 - 1. Two adjacent bridge decks.
 - 2. Bridge deck and abutment backwall.
 - 3. Approach slab and sleeper slab stem.
- B. Removal of existing pourable joint seal and installation of new pourable joint seal between:
 - 1. Two adjacent bridge decks.
 - 2. Bridge deck and abutment backwall.
 - 3. Approach slab and sleeper slab stem.

1.2 RELATED SECTIONS

- A. Section 03924: Structural Concrete Repair

1.3 REFERENCES

- A. ASTM C 639: Rheological (Flow) Properties of Elastomeric Sealants
- B. ASTM C 661: Indentation Hardness of Elastomeric – Type Sealants by Means of a Durometer
- C. ASTM C 679: Tack-Free Time of Elastomeric Sealants
- D. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
- E. ASTM C 1246: Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants After Cure
- F. ASTM D 412: Vulcanized Rubber and Thermoplastic Elastomers – Tension
- G. ASTM D 1790: Brittleness Temperature of Plastic Sheeting by Impact
- H. ASTM D 4285: Indicating Oil or Water in Compressed Air

- I. ASTM D 5249: Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pourable Seal
1. Capable of bonding to concrete and steel.
 2. Capable of accommodating the movement as shown.
 3. Applicable for use on high volume vehicular traffic joints.
 4. Meet the properties listed in Table 1.

Table 1

Property	Requirements	Test Method
Leveling	Self Levels	ASTM C 639
Tack Free Time	60 minutes max.	ASTM C 679
Movement Capability	+100% -50%	ASTM C 719
Tensile Strength	120 psi	ASTM D 412
Ultimate Elongation	1000% min.	ASTM D 412
Stress at 150% Elongation	25 psi max.	ASTM D 412
Hardness (Shore A)	30 ±10	ASTM C 661
Low Temperature Flexibility at -40°F	Pass	ASTM D 1790
Heat Aging	2%	ASTM C 1246

- B. Backer Rod
1. Size backer rod to be $\frac{1}{8}$ inch larger than opening at time of installation.
 2. Use a closed cell, polyethylene-foam rod joint filler.
 - a. Meet the requirements of ASTM D 5249 Type 1.

PART 3 EXECUTION

3.1 REMOVAL

- A. Remove existing joint seal as shown.
- B. Choose a removal method that will not damage the adjacent concrete or steel.

3.2 PREPARATION

- A. Provide tooled radius on joint edges as shown.
 - 1. Grind existing concrete as necessary to create radius.
- B. Remove loose or spalled concrete and repair to create a smooth, uniform surface for the joint system to bond to.
 - 1. Refer to Section 03924.
- C. Sandblast entire joint.
 - 1. Meet the requirements of ASTM D 4285.
- D. Remove sand left by sandblasting from the joint and surrounding traffic surfaces using compressed air.
- E. Joint area must be completely dry before installation.
- F. Install joint system when the ambient and substrate temperature is above 45 degrees F.
 - 1. Comply with manufacturer's installation instruction including environmental limitations.

3.3 INSTALLATION

- A. Install the top of the pourable joint seal at least $\frac{1}{4}$ inch below the traffic surface.
 - 1. Set the depth of the backer rod to meet the manufacturer's minimum thickness requirements for the pourable joint seal.
- B. Follow the manufacturer's installation instructions.

END OF SECTION

SECTION 05830

ASPHALTIC PLUG JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic plug joint system for sealing expansion joints in bridge decks and approach slabs with asphalt or concrete overlay.
- B. Removal of existing expansion joint system.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02075: Geotextiles
- C. Section 03152: Concrete Joint Control
- D. Section 03310: Structural Concrete
- E. Section 03392: Penetrating Concrete Sealer
- F. Section 03934: Structural Pothole Patching

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 270: Structural Steel for Bridges
- C. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- D. ASTM D 4285: Indicating Oil or Water in Compressed Air
- E. ASTM D 5249: Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
- F. ASTM D 6297: Asphaltic Plug Joints for Bridges

1.4 DEFINITIONS

- A. Traffic Bearing Plate – Steel plate to span over the expansion joint width as shown.

1.5 SUBMITTALS

- A. Manufacturer's product data sheet and installation instructions.
- B. Certificate of Compliance for the Elastomeric Binder.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphaltic Plug Matrix
 - 1. Aggregate
 - a. Consisting of granite, basalt, gabbro, porphyry or gritstones.
 - b. Use crushed double washed aggregate.
 - c. Meet manufacturer gradation requirements.
 - 2. Elastomeric Binder
 - a. Use a thermoplastic polymeric modified asphalt, thermoplastic polymer-modified asphalt sealant, or modified elastomeric binder meeting the requirements of ASTM D 6297 Table 1.
- B. Backer Rod
 - 1. Backer rod sized to be $\frac{1}{8}$ inch larger than opening at time of installation.
 - 2. Use a closed cell, polyethylene-foam rod joint filler.
 - a. Meet the requirements of ASTM D 5249 Type 1.
- C. Structural Steel – Galvanize all structural steel according to AASHTO M 111.
 - 1. Plates – AASHTO M 270, Grade 36
 - 2. Steel pipe – ASTM A 53 Grade B
- D. Plywood – Panel grade C or D, $\frac{3}{4}$ inch thickness.
- E. Joint Sealer (Structures) – according to Section 03152.
- F. Silicone Joint Sealer – according to Section 03152
- G. Penetrating Concrete Sealer – according to Section 03392.

- H. Separation Geotextile – according to Section 02075.
- I. Free Draining Granular Backfill – according to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

- A. Label containers containing elastomeric binder with the following:
 - 1. Manufacturer's name
 - 2. Lot or batch number
 - 3. Date of manufacture
 - 4. Date of packaging
 - 5. The shelf date, if any, beyond which the binder is not used
 - 6. Manufacturer's storage and handling recommendations
- B. Remove existing expansion joint system and asphalt when shown.
- C. Drill drain hole in concrete deck or approach slab as shown.
 - 1. Use drill capable of coring cleanly through asphalt membrane, concrete, and steel reinforcing bars.
- D. Clean drain hole of all dust and debris and apply penetrating concrete sealer to the walls of the hole.
- E. Place drain and separation geotextile
 - 1. Place galvanized steel drain assembly and seal using silicone joint sealer as shown.
 - 2. Place free draining granular backfill as shown.
- F. Place plywood directly on clean concrete deck to cover joint.
- G. Asphalt Pavement Preparations
 - 1. Place the asphalt overlay.
 - 2. Saw cut and remove asphalt to the dimensions shown to create blackout.
 - a. Set saws to cut the full depth of the wearing surface.
 - 1) Do not damage the concrete deck, sleeper slab, approach slab, or asphaltic concrete that remains in place.
 - b. Do not allow traffic or construction equipment to cross the cut edge.

- H. Concrete Pavement Preparation
 - 1. Form the blockout for the asphalt plug joint according to Section 03310.
 - 2. Place the concrete overlay as shown.
- I. Remove plywood, forms, or rigid plastic foam from the blockout.
- J. Thoroughly clean and dry the entire blockout.
 - 1. Remove small debris using compressed air.
 - 2. Sandblast the length of the blockout to clean any remaining debris on the vertical walls and adjacent deck area.
 - 3. Meet the requirements of ASTM D 4285 for compressed air and sandblaster.
- K. Remove and repair spalled and defective concrete material within the blockout according to Section 03934.

3.2 INSTALLATION

- A. Install joint seal when the weather conditions meet the manufacturer's installation instructions.
- B. Apply joint sealer (structures) and backer rod to the joint.
 - 1. Place the top of the backer rod at least 1 inch and no more than the width of the existing joint, below the bottom of the blockout.
 - 2. Place a small amount of hot binder onto the joint sealer (structures) to adequately plug the joint.
- C. Coat the blockout with a thin layer of hot binder immediately after cleaning and applying joint sealer (structures).
- D. Install the traffic bearing plate centered over the gap, butt jointed, and placed so that the plates lay flat on the bottom of the blockout.
 - 1. Place so that there are no overlaps in the sections or gaps between the plate and blockout.
 - 2. Provide a traffic bearing plate that is at least 4 inches wider than the maximum movement rating for the joint.
 - 3. Coat the top of the plate with a thin layer of hot binder after the locating pins are in place.
- E. Follow the manufacturer's installation recommendations for the proportioning, heating temperatures, mixing, placing, and finishing procedures of the aggregate and binder.

- F. Place matrix in lifts according to the manufacturer's recommendations.
 - 1. Do not exceed a lift height of 2 inches.
 - 2. Place matrix to finished grade as shown.
- G. Seal top surface of asphaltic plug joint as recommended by the manufacturer.
 - 1. Extend seal a minimum of 2 inches onto asphalt or concrete surface.

END OF SECTION

SECTION 05831

COMPRESSION JOINT SEAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Compression joint seal for bridge decks and approach slabs.
- B. Removal of existing joint from bridge deck and approach slabs.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM C 307: Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
- B. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- C. ASTM C 661: Indentation Hardness of Elastomeric – Type Sealants by Means of a Durometer
- D. ASTM C 711: Low-Temperature Flexibility and Tenacity of One-Part Elastomeric, Solvent-Release Type Sealants
- E. ASTM C 881: Epoxy-Resin-Base Bonding Systems for Concrete
- F. ASTM D 412: Vulcanized Rubber and Thermoplastic Elastomers - Tension
- G. ASTM D 545: Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)
- H. ASTM D 3542: Preformed Polychloroprene Elastomeric Joint Seals for Bridges
- I. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures
- J. ASTM D 4285: Indicating Oil or Water in Compressed Air

- K. ASTM D 5329: Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic Pavements and Portland Cement Concrete Pavements
- L. ASTM G 155: Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

1.4 DEFINITIONS

- A. Compression Joint Seal – A joint seal placed in compression before installation and kept in compression during its life.
 - 1. Seals the joint as shown to prevent water from seeping through the joint.
- B. Elastomeric Joint Seal – preformed open cell, vulcanized elastomeric compound using virgin polychloroprene as the only polymer
- C. Silicone Coating – factory applied, external facing applied to the foam at a width greater than the maximum joint extension and cured before final compression.
- D. Type A – open cell, pre-compressed, self-expanding, polyurethane foam with factory applied highway-grade silicone joint seal.
- E. Type B – preformed, open cell, vulcanized elastomeric joint seal.
- F. Watertight – no free dripping water or patches of moisture on any surface under the joint.

1.5 SUBMITTALS

- A. Manufacturer's product data sheet and installation instructions.
- B. Removal Plan for review.
 - 1. Include method of removal and preparation of existing surface.
 - 2. Equipment to be used.
- C. Calculated stretch of the joint seal for information. Refer to this Section 3.4D.
- D. Repair procedure for review. Refer to this Section 3.5C1.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Compression Joint Seal Type A
1. Movement rating as shown.
 2. Cellular polyurethane foam impregnated with hydrophobic 100 percent acrylic, water-based emulsion.
 - a. Impregnation agent with non-migratory characteristics.
 - b. Meet the requirements of Table 1.

Table 1

Physical Properties	Test Method	Requirement
Temperature Service Range	ASTM C 711	-40°F to 185°F
Density	ASTM D 545	12.5 lb/ft ³

3. Silicone Coating
 - a. Non-sag, highway-grade, and fuel resistant.
 - b. Creates a bellows in the coating when compressed.
 - c. Meet the requirements of Table 2.
 - d. Capable of movements of plus or minus 50 percent of nominal material size.

Table 2

Physical Properties	Requirement	Test Method
UV Resistance	No changes in 2000 hours	ASTM G 155
Adhesion, minimum elongation	500	ASTM D 5329
Elongation	>1400%	ASTM D 412
Resilience	≥ 95%	ASTM D 5329
Stress @ 150% Elongation	22 psi	ASTM D 412
Hardness, maximum 21 day cure (shore 00)	85	ASTM C 661

4. Epoxy Adhesive according to ASTM C 881, Type I, Grade 3.
5. Silicone Sealant Bands.
 - a. Meet the requirements in Table 2.
 - b. Non-sag, Highway-grade and fuel resistant.

- c. Capable of movements of +50 percent and -50 percent (100 percent total) of nominal material size.
- B. Compression Joint Seal Type B
 - 1. Movement rating as shown.
 - 2. Elastomeric Joint Seal
 - a. The seal height is at least 90 percent of the nominal width.
 - b. Meet the physical properties of ASTM D 3542.
 - 3. Adhesive lubricant according to ASTM D 4070.
 - a. Capable of bonding to concrete or steel surfaces.
- C. Epoxy Grout
 - 1. Use a non-shrink epoxy grout patching material.
 - 2. Provide a minimum compressive strength of 3,000 psi in 1 day and 5,000 psi in 28 days according to ASTM C 579.
 - 3. Provide a minimum tensile strength of 2,000 psi according to ASTM C 307.

PART 3 EXECUTION

3.1 PREPARATION

- A. Compression Seal Type A
 - 1. Concrete
 - a. Remove loose particles and weak concrete.
 - b. Repair spalls, chipped edges, and uneven surfaces using epoxy grout.
 - c. Remove contaminants by sandblasting.
 - 1) Verify no oil or water contamination according to ASTM D 4285.
 - d. Prepare the surface as required by the manufacturer.
 - 2. Metal
 - a. Sandblast according to ASTM D 4285 to rough, white metal and solvent-wipe immediately before applying epoxy adhesive primer.
 - b. Prepare the surface as required by the manufacturer.
 - 3. Verify the joint seal size based on the prepared surface and installation temperature.
 - 4. Store all materials indoors at room temperature until needed at time of installation.
- B. Compression Seal Type B
 - 1. Clean finished concrete joint surfaces by sandblasting.
 - a. Verify no oil or water in compressed air according to ASTM D 4285.

- b. Remove unsound materials, adhesive, and contaminants.
2. Provide joint openings that are smooth, true and vertical.
 - a. Joint opening faces are parallel and the width will not vary by more than $\frac{1}{8}$ inch over 10 ft along the length of the joint.
 - b. Repair vertical surface imperfections, including saw blade gouges, greater than $\frac{1}{16}$ inch with epoxy grout.
3. Prepare the surface as required by the manufacturer.

3.2 REPLACEMENT INSTALLATION

- A. Remove existing joint system according to the authorized Removal Plan.
- B. Compression Seal Type A
 1. Install compression joint seal according to this Section 3.4A.
- C. Compression Seal Type B
 1. Avoid damaging existing concrete.
 2. Saw cut the vertical joint opening concrete surfaces as required to achieve the appropriate width and depth as shown.
 3. Prepare joint according to this Section 3.1B.
 4. Install Compression Joint Seal according to this Section 3.4B.

3.3 NEW INSTALLATION

- A. Compression Seal Type A
 1. Install joint seal according to this Section 3.4A.
- B. Compression Seal Type B
 1. The blockout width for the joint will be within $\frac{1}{8}$ inch for joints less than or equal to $2\frac{1}{2}$ inch and $\frac{1}{4}$ inch for joints greater than $2\frac{1}{2}$ inch of the width shown.
 - a. The blockout width corresponds to the appropriate ambient temperature at the time of concrete placement.
 2. Saw cut the vertical joint opening in concrete surfaces as required, to achieve the appropriate width and depth as shown.
 3. Prepare joint according to this Section 3.1B.
 4. Install Compression Joint Seal according to this Section 3.4B.

3.4 SEAL INSTALLATION

- A. Compression Seal Type A
 1. Install the joint seal according to manufacturer's specifications.
 2. Apply epoxy adhesive to the substrate.
 - a. Prepare the joint again according to this Section 3.1A and manufacturer's recommendations if the epoxy cures before placement of seal.

3. Install joint seal at least $\frac{1}{2}$ inch below the traffic surface or according to manufacturer's installation instructions, whichever is larger.
 4. Clean silicone coating at joint edges and apply sealant bands according to the manufacturer's installation instructions.
 5. Coat exposed foam ends with a light coating of silicone.
- B. Compression Seal Type B
1. Supply the longest continuous length of compression seal possible.
 - a. Field splices will be allowed, when required by staging.
 - b. Field splice according to manufacturer's requirements.
 2. Install compression joint seal according to the manufacturer's installation instructions.
 - a. Cut the compression joint seal length to the exact width of the pavement.
 - b. Cut upturn and downturn bends according to manufacturer's installation instructions.
- C. Insert compression joint seal into the joint blockout with tools that will not damage the seal.
- D. Install the compression seal without stretching more than 4 percent.
1. Calculate stretch by dividing the excess length by the original length.
 - a. Stretch greater than 4 percent is unacceptable and requires that the seal be replaced.
 2. Provide the Engineer the calculated stretch.
- E. Install compression joint seal so the top of the seal is $\frac{1}{4}$ inch $\pm \frac{1}{16}$ inch below the traffic surface.

3.5 WATERTIGHT INTEGRITY TEST

- A. Perform a watertight integrity test on the joint system at least five calendar days after the joint has been installed.
1. Test full width or staged width of the joint system as shown.
 2. Perform the watertight integrity test in the presence of the Engineer.
- B. Pond at least 2 inch of water over the joint for 15 minutes where:
1. Joints are over steel or concrete surfaces that can be inspected.
 - a. Inspect the steel and concrete surfaces for any evidence of dripping water or moisture for the initial 15 minutes and for 45 minutes after the ponded water has been released.

2. Joints are over steel or concrete surfaces that cannot be inspected.
 - a. Measure and record the initial depth of the ponded water.
 - b. Measure and record the depth of the ponded water after 15 minutes.
 - c. The test can be stopped if depth of ponded water has not changed $\frac{1}{8}$ inch or more.
 - d. Continue the test for an additional 15 minutes if depth of water has changed more than $\frac{1}{8}$ inch.
 - 1) Measure and record the depth of the ponded water.
 - 2) The test is considered a failure if the water level has changed by an additional $\frac{1}{8}$ inch or more.
- C. Locate the places in the joint system where leakage is occurring and take measures necessary to stop the leakage.
 1. Submit a repair procedure recommended by the manufacturer.
 2. Repair joint system according to the authorized manufacturer's recommended repair procedure.
 3. Repeat watertight integrity test.

END OF SECTION

SECTION 05832

STRIP SEAL EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Strip seal expansion joint for bridge decks and approach slabs.
- B. Removal of existing expansion joint system.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete
- D. Section 05120: Structural Steel

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 169: Steel Bars, Carbon, and Alloy, Cold-Finished
- C. AASHTO M 235: Epoxy Resin Adhesives
- D. AASHTO M 270: Structural Steel for Bridges
- E. AASHTO/AWS D1.5: Bridge Welding Code
- F. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- G. ASTM D 395: Rubber Property – Compression Set
- H. ASTM D 412: Vulcanized Rubber and Thermoplastic Elastomers – Tension

- I. ASTM D 471: Rubber Property – Effect of Liquids
- J. ASTM D 573: Rubber – Deterioration in an Air Oven
- K. ASTM D 1149: Rubber Deterioration – Cracking in an Ozone Controlled Environment
- L. ASTM D 2240: Rubber Property – Durometer Hardness
- M. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures
- N. ASTM D 5973: Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing
- O. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

- A. Expansion Joint System – Extruded elastomeric seal element inserted into and bonded to a steel extrusion.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of all fabricated materials for review.
 - a. Include the following:
 - 1) Joint seal assembly, anchorage components, and method of installation.
 - 2) Concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel, and other components.
 - b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
- B. Materials
 - 1. Mill Test Report (MTR) for all structural steel for information.
 - a. Provide item number and name on all material submittals.
 - b. Refer to Section 05120.
 - 2. Documentation of manufacturer's AISC Bridge Component QMS (CPT) Certification for information.
 - 3. Welding procedure specifications meeting AASHTO/AWS D 1.5. for information.

- C. Manufacturer's product data sheet and installation instructions.
- D. Manufacturer's SBR certification for information.
- E. Repair procedures for review.
 - 1. Required when watertight integrity test fails.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Class AA(AE) refer to Section 03055.
- B. Structural Steel
 - 1. Steel Extrusions – AASHTO M 270, Grade 36
 - 2. Plates – AASHTO M 270, Grade 36
 - 3. Round Bars – AASHTO M 270, Grade 36
 - 4. Studs – AASHTO M 169
 - 5. Galvanize all structural steel according to AASHTO M 111.
- C. Lubricating Adhesive
 - 1. Follow manufacturer's recommendation and ASTM D 4070.
- D. Epoxy Resin Adhesive
 - 1. AASHTO M 235, Type II.
 - 2. Choose class rating consistent with the application temperature.
- E. Reinforcing Steel
 - 1. Use coated reinforcing steel according to Section 03211.
- F. Rigid Plastic Foam
 - 1. Type 9. Refer to ASTM C 578.
- G. Elastomeric Seal
 - 1. Single layer strip type.
 - 2. Continuous with no splices unless approved by the Engineer.

3. Conforming to the properties listed in Table 1.

Table 1

Property	Requirement	Test Method
Tensile Strength	2000 psi	ASTM D 412
Elongation at Break	250%	ASTM D 412
Hardness, Type A Durometer	60 ± 5%	ASTM D 2240*
Oven Aging 70 hrs at 212°F Tensile Strength Elongation Hardness	20% loss max 20% loss max 0 to +10 points	ASTM D 573
Oil Swell, 70 hrs at 212°F	45%	ASTM D 471
Ozone Resistance, 70 hrs at 104°F 20% strain, 300 pphm, in air	No Cracks	ASTM D 1149
Low Temperature Stiffening 7 days at 14°F Hardness (Type A durometer)	0 to +15 points	ASTM D 2240
Compression Set, 70 hrs at 212°F	35%	ASTM D 395

*As modified by ASTM D 5973.

2.2 FABRICATION

- A Refer to Section 05120, except AISC Bridge Component QMS (CPT) Certification is required.
- B. Check the elastomeric seal and top of the extruded steel shape of each section for straightness after expansion joint and anchorage system fabrication.
 - 1. Use a string line stretched taut from curb angle point to curb angle point or necessary construction joint end.
- C. Shop Tolerances
 - 1. Do not deviate in straightness by more than $\frac{1}{8}$ inch for steel surfaces.
 - 2. Do not deviate more than $\frac{3}{32}$ inch for surfaces when string line is stretched between ends and the point of maximum departure from true.

PART 3 EXECUTION

3.1 EXPANSION JOINT MODIFICATION PREPARATION

- A. Asphalt Removal
 - 1. Make saw cuts parallel to existing joints to define the removal area.
 - 2. Remove asphalt surfacing in such a manner that the concrete deck is not damaged.
- B. Concrete Saw Cuts
 - 1. Locate the saw cuts at the offset as shown and saw 1 inch deep in the concrete deck parallel to existing joints to define work area.
- C. Prevent debris from falling into streams, pedestrian areas, traffic areas, and on railroad tracks.

3.2 CONCRETE REMOVAL FOR EXPANSION JOINT MODIFICATION

- A. Use jackhammer method to remove existing concrete.
 - 1. Partial Depth Removal – Use 45-pound class hand operated jackhammers or smaller.
 - 2. Full Depth Removal – Use 90-pound class hand operated jackhammers or smaller.
 - a. Use 45 pound class hand-operated jack hammer or smaller when removing concrete within 6 inches of girders, diaphragms, deck that are to remain.
 - 3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.
- B. Parapet
 - 1. Remove parapet concrete as shown.
 - 2. Protect existing electrical conduit from damage.

3.3 REINFORCING STEEL FOR EXPANSION JOINT MODIFICATION

- A. Protect and clean existing reinforcing steel to remain as shown.
 - 1. Clean corrosion and adhering materials by sandblasting.
- B. Place new reinforcing steel after sandblasting operations are complete.

3.4 EXPANSION JOINT SYSTEM INSTALLATION

- A. Install expansion joint system according to the authorized shop drawings.
- B. Prevent twists, bends, and warping when handling strip seal.

- C. Provide a factory-trained representative during system setting, concrete placement, elastomeric seal element installation, and during the watertight integrity test.
 - 1. The Engineer may waive the requirement for the manufacturer's representative to be onsite if the Installer can demonstrate that the Installer's superintendent for the work has performed at least two satisfactory applications of the modular expansion joint in the last five years.
 - a. The manufacturer's technical representative must be available for consultation throughout the duration of the application.
 - 2. The Department reserves the right to require the manufacturer's technical representative to be onsite if at any time the Engineer is concerned with the product installation quality.

3.5 JOINT WIDTH

- A. Form the joint width using rigid plastic foam as shown.
 - 1. Anchor securely.
- B. Maintain separation of sections by placing rigid plastic foam between sections of the concrete parapet.
- C. Form parapet joint width with rigid plastic foam as shown.

3.6 CONCRETE

- A. Clean concrete and steel surfaces before coating with an epoxy resin adhesive.
 - 1. Follow epoxy resin adhesive manufacturer's installation instructions.
- B. Place and finish concrete according Section 03310.
- C. Place concrete not to impede free movement of expansion joint.

3.7 ELASTOMERIC SEAL

- A. Install elastomeric seals before shipping unless field splices of expansion joint are required.
- B. Install elastomeric seals in the field after construction is complete if field splices are necessary.
- C. Lubricate the steel extrusion cavity before installing the elastomeric seal.

- D. Remove the rigid plastic foam used to form the joint opening and any other objects that may interfere with the installation and operation of the elastomeric seal so the seal convolution hangs freely after installation.

3.8 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

- A. Field Tolerances for Expansion Joint
 - 1. Re-examine steel surfaces for straightness and shop tolerance requirements after installing joint system in its final position and before placing concrete.
- B. Final In-place Tolerances for Expansion Joint
 - 1. Re-examine the extrusion gland face after concrete placement.
 - a. Deviations from the string line of more than $\frac{1}{4}$ inch are not allowed.
 - b. Do not deviate parallel extrusion faces from each other by more than $\frac{1}{8}$ inch at any location.
- C. Test expansion system in the presence of the Engineer to verify that joint areas can hold a minimum depth of 3 inches of water for one hour without leakage.
- D. Provide recommended repair for failed watertight integrity test.
 - 1. If joint fails the watertight integrity test after the repair, remove leaking seals, clean steel extrusion grooves, and install new seals if leaking occurs during testing.

END OF SECTION

SECTION 05835

MODULAR EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Modular expansion joint system and recessed parapet cover plate for bridge decks and approach slabs.
- B. Removal of existing expansion joint system from bridge deck.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03211: Reinforcing Steel and Welded Wire
- C. Section 03310: Structural Concrete
- D. Section 05120: Structural Steel

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- C. AASHTO M 235: Epoxy Resin Adhesives
- D. AASHTO M 270: Structural Steel for Bridges
- E. AASHTO M 291: Carbon and Alloy Steel Nuts
- F. AASHTO M 293: Hardened Steel Washers
- G. AASHTO/AWS D 1.5: Bridge Welding Code (Joint Publication)
- H. AASHTO LRFD Bridge Design Specifications
- I. AASHTO LRFD Bridge Construction Specifications
- J. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

- K. ASTM D 4070: Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures
- L. ASTM D 5973: Elastomeric Strip Seals with Steel Locking Edge Rails Used in Expansion Joint Sealing
- M. ASTM F 3125: High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
- N. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

- A. Modular Expansion Joint System – An extruded joint with two or more neoprene seals held in place by edgebeams that are anchored to the structural elements such as decks and abutment and one or more transverse centerbeams parallel to the edgebeams.

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of all fabricated materials for review.
 - a. Include the following:
 - 1) Joint seal assembly, anchorage components, and method of installation.
 - 2) Concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel, or other components.
 - b. Provide the seal of a Professional Engineer (PE) or Professional Structural Engineer (SE) licensed in the State of Utah.
 - c. Include supporting engineering calculations according to the AASHTO LRFD Bridge Design Specifications for all components of the modular expansion joint system.
 - 2. Temporary bridging plan for modular expansion joint for review.
 - a. Required where construction traffic is anticipated following installation.
- B. Materials
 - 1. Mill Test Report (MTR) for all structural steel for information.
 - a. Provide item number and name on all material submittals.
 - b. Refer to Section 05120.
 - 2. Documentation of manufacturer's AISC Bridge Component QMS (CPT) Certification for information.

- 3. Welding procedure specifications meeting AASHTO/AWS D 1.5.
- C. Manufacturer's product data sheet and installation instructions.
- D. Repair procedures for review.
 - 1. Required when watertight integrity test fails.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete
 - 1. Class AA (AE) refer to Section 03055.
- B. Structural Steel
 - 1. Steel Extrusions AASHTO M 270, Grade 36
 - 2. Plates AASHTO M 270, Grade 36
 - 3. Round Bars AASHTO M 270, Grade 36
 - 4. Shear Studs AASHTO M 270, Grade 36
 - 5. Welding AASHTO/AWS D1.5
 - 6. Galvanize according to AASHTO M 111 except for stainless steel and steel surfaces coated with PTFE.
- C. Bolts, Nuts, and Washers – Galvanize according to AASHTO M 232.
 - 1. Bolts ASTM F 3125, Grade A325
 - 2. Nuts AASHTO M 291
 - 3. Washers AASHTO M 293
- D. Lubricating Material
 - 1. Follow manufacturer's recommendation and ASTM D 4070.
- E. Epoxy Resin Adhesive
 - 1. AASHTO M 235, Type II.
 - 2. Choose class rating consistent with the application temperature.
- F. Reinforcing Steel
 - 1. Use coated reinforcing steel according to Section 03211.
- G. Rigid Plastic Foam
 - 1. Type 9 refer to ASTM C 578.

- H. Elastomeric Gland Seal – Refer to ASTM D 5973.
 - 1. Single layer strip type.
 - 2. Continuous with no splices unless approved by the Engineer.

2.2 JOINT SYSTEMS

- A. Use only one modular expansion joint system on any single project.
- B. The following systems are acceptable:
 - 1. D. S. Brown Modular Expansion Joint Systems.
 - 2. Watson Bowman Acme Modular Expansion Joint Systems.
 - 3. Other approved equivalent systems.
- C. Design and test according to the current edition of the AASHTO LRFD Bridge Design Specifications and the AASHTO LRFD Bridge Construction Specifications.

2.3 FABRICATION

- A. Modular Expansion Joint
 - 1. Comply with Section 05120, except AISC Bridge Component QMS (CPT) Certification is required.
- B. Check the gland face and top of the extruded steel shape of each section for straightness after expansion joint and anchorage system fabrication.
 - 1. Use a string line stretched taut from curb angle point to curb angle point.
- C. Shop Tolerances
 - 1. Do not deviate from the string line by more than $\frac{1}{8}$ inch for steel surfaces.
 - 2. Do not deviate more than $\frac{3}{32}$ inch for any surface when the string line is stretched between either end or crown point and the point of maximum departure from true.

PART 3 EXECUTION

3.1 MODULAR EXPANSION JOINT MODIFICATION PREPARATION

- A. Asphalt Removal
 - 1. Make saw cuts parallel to existing joints to define the removal area.
 - 2. Remove asphalt surfacing in a manner that will not damage the concrete deck.

- B. Concrete Saw Cuts
 - 1. Place the saw cuts at the offset shown.
 - 2. Saw cut 1 inch deep in the concrete deck parallel to existing joints to define work area.
- C. Prevent debris from falling into streams, pedestrian areas, traffic areas, and on railroad tracks.

3.2 CONCRETE REMOVAL FOR MODULAR EXPANSION JOINT MODIFICATION

- A. Use jackhammer method to remove existing concrete.
 - 1. Partial Depth Removal – Use 45-pound class hand operated jackhammers or smaller.
 - 2. Full Depth Removal – Use 90-pound class hand operated jackhammers or smaller.
 - a. Use 45 pound class hand-operated jack hammer or smaller when removing concrete within 6 inches of girders, diaphragms, deck that are to remain.
 - 3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.
- B. Parapet
 - 1. Remove parapet concrete as shown.
 - 2. Protect the conduit from damage where existing electrical conduit is encountered.

3.3 REINFORCING STEEL FOR MODULAR EXPANSION JOINT MODIFICATION

- A. Existing Reinforcing Steel
 - 1. Clean thoroughly by sandblasting, steel that remains in place of corrosion and adhering materials.
- B. New Reinforcing Steel
 - 1. Place coated reinforcing steel after sandblasting operations are complete.

3.4 SYSTEM INSTALLATION

- A. Install expansion joint system according to the manufacturer's recommendations.

- B. Provide a factory-trained representative during system setting, concrete placement, elastomeric seal element installation, and during the watertight integrity test.
 - 1. The Engineer may waive the requirement for the manufacturer's representative to be onsite if the Installer can demonstrate that the Installer's superintendent for the work has performed at least two satisfactory applications of the modular expansion joint in the last five years.
 - a. The manufacturer's technical representative must be available for consultation throughout the duration of the application.
 - 2. The Department reserves the right to require the manufacturer's technical representative to be onsite if at any time the Engineer is concerned with the product installation quality.
- C. Verify the assembly provides a smooth riding joint without slapping of components or wheel rumble.

3.5 JOINT WIDTH

- A. Form the joint width as shown using rigid plastic foam.
 - 1. Anchor securely.
- B. Place rigid plastic foam between sections of concrete parapet to maintain separation of sections.

3.6 CONCRETE

- A. Clean concrete and steel surfaces before coating with an epoxy adhesive.
 - 1. Follow adhesive manufacturer's application instructions.
- B. Place concrete.
 - 1. Refer to Section 03310.
- C. Keep traffic off the expansion joint system for 72 hours after placing concrete and concrete has reached its design strength.
- D. Place concrete not to impede free movement of expansion joint.

3.7 JOINT GLANDS

- A. Install joint glands before shipping unless field splicing modular expansion joint is necessary.
- B. Install the joint glands in the field after construction is complete if field splice is necessary.

- C. Lubricate the steel extrusion cavity before installing the neoprene gland.
- D. Remove the foam used to form the joint opening and any other objects before watertight integrity test.
 - 1. Gland convolution must hang freely after installation.

3.8 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

- A. Field Tolerances for Expansion Joint
 - 1. Re-examine steel surfaces for straightness and shop tolerance requirements after installing joint system in its final position and before placing concrete.
- B. Final In-place Tolerances for Expansion Joint
 - 1. Re-examine the extrusion gland face after concrete placement.
 - 2. Deviations from the string line of more than $\frac{1}{4}$ inch are not allowed.
 - 3. The parallel extrusion faces must not deviate from each other by more than $\frac{1}{8}$ inch at any location.
- C. Test expansion system in the presence of the Engineer to verify that joint areas can hold a minimum depth of 3 inches of water for one hour without leaking.
- D. Provide recommended repair for failed watertight integrity test.
 - 1. If joint fails the watertight integrity test after the repair, remove leaking seals, clean steel extrusion grooves, and install new seals if leaking occurs during testing.

3.9 RECESSED PARAPET COVER PLATE

- A. Place recessed parapet and sidewalk cover plates as shown.

END OF SECTION

SECTION 06055

TIMBER AND TIMBER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Timber for signs, guardrails, and posts, and the preservative treatment for timber.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. AASHTO M 133: Preservatives and Pressure Treatment Processes for Timber
- B. AASHTO M 168: Wood Products
- C. Southern Pine Inspection Bureau (SPIB) Standard Grading Rules
- D. Western Wood Products Association (WWPA) Standard Grading Rules

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

PART 2 PRODUCTS

2.1 STRUCTURAL TIMBER AND LUMBER

- A. Refer to AASHTO M 168.
- B. Treat, if required, using preservative. Refer to AASHTO M 133.

2.2 POSTS

- A. Pressure treated wood posts that comply with the current WWPB Standard Grading Rules or SPIB Grading Rules.
- B. Temporary Use Sign Posts
 - 1. Use only one type of wood species on any one project.
 - 2. S4S, 80 percent FOHC, Douglas Fir-Larch, Grade No. 2 or better.
 - 3. Hem-fir, Lodgepole Pine, Ponderosa Pine, or Southern Yellow Pine, Grade No. 1 or better.
- C. Guardrail Post
 - 1. Use only one species of wood on any one project.
 - 2. Surfaced or rough-sawn posts and offset blocks.
 - 3. Douglas Fir-Larch, Hem-Fir, Lodgepole Pine, Ponderosa Pine, or Southern Yellow Pine.
 - 4. Grade No. 1 or better.
- D. Steel Post with Wood Block
 - 1. Routed wood offset block of Douglas Fir or Southern Yellow Pine.
 - 2. Surfaced or rough sawn blocks.
 - 3. Grade No. 1.

2.3 TREATMENT

- A. Meet requirements of AASHTO M 133.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 07105

WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Waterproofing membrane for concrete bridge decks and approach slabs.

1.2 RELATED SECTIONS

- A. Section 03934: Structural Pothole Patching

1.3 REFERENCES

- A. ASTM D 5: Penetration of Bituminous Materials
- B. ASTM D 36: Softening Point of Bitumen (Ring-and-Ball Apparatus)
- C. ASTM D 146: Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
- D. ASTM D 882: Tensile Properties of Thin Plastic Sheeting
- E. ASTM D 3236: Apparent Viscosity of Hot Melt Adhesives and Coating Materials
- F. ASTM E 96: Water Vapor Transmission of Materials
- G. ASTM E 154: Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.

1.6 WEATHER LIMITATIONS

- A. Do not work during wet conditions or when the deck or ambient air temperatures are below 50 degrees F.

- B. Do not apply the membrane until it has been a minimum of 12 hours since the deck surface was wet and is dry per the manufacturer's requirements.

PART 2 PRODUCTS

2.1 RUBBERIZED ASPHALT MEMBRANE

- A. Characteristics
1. Laminate form
 2. Heat resistant
 3. Self-adhesive surface protected by special release paper
- B. Mechanical Properties – Refer to Table 1:

Table 1

Mechanical Properties		
Property	Value	Method
Thickness, inch, minimum	0.065	
Permeance-Perms, grains/sq ft·hr·inhg	0.10	ASTM E 96, Method B
Tensile Strength, psi	50	ASTM D 882, modified for 1 inch opening
Elongation, percent	75	ASTM D 882, modified for 1 inch opening
Puncture Resistance (Mesh), lb	200	ASTM E 154
Pliability, at -15 degrees F	No cracks in mesh or rubberized asphalt when bent 180 degrees over a ¼ inch mandrel	ASTM D 146

2.2 FIBERGLASS MATTING

- A. Weight = 1.5 lb/yd²

2.3 BINDER

- A. Compatible with the matting material and conforming to the following requirements:

Table 2

Binder Requirements		
Property	Value	Method
Penetration, 0.1 mm	40-82	ASTM D 5
Softening point, min.	155 degrees F	ASTM D 36
380 degrees F. viscosity, cps	1,000 – 1,800	ASTM D 3236

PART 3 EXECUTION

3.1 PREPARATION

- A. Expansion Joint Modification and Joint Closure
1. Remove the curing cover materials and dry according to manufacturer's recommendations or 48 hours, whichever is greater after concrete placed at expansion joint modifications and joint closures has cured.
- B. Concrete Deck
1. Sandblast to remove asphalt and all other foreign material from the entire deck, approach slabs, and sides of the parapet for a height of 4 inches above the concrete deck.
 2. Vacuum or use compressed air to remove all dust and loose material from the deck.
 3. Remove all sharp ridges and projections that can puncture the membrane.
 4. Patch holes or spalled areas in the concrete deck with patching concrete to provide a flat deck surface. Refer to Section 03934.
- C. Joints and Cracks
1. Bond a 12 inch wide strip of woven fiberglass reinforcing to the deck over cracks and cold joints greater than $\frac{3}{16}$ inch wide using a compatible binder.

3.2 APPLY MEMBRANE

- A. Rubberized asphalt membrane – Follow membrane manufacturer's recommendations for application temperatures, equipment, and procedures.
1. Primer
 - a. Use primer furnished by the manufacturer of membrane material.
 - b. Apply primer to all surfaces to be covered by the membrane according to the manufacturer's recommended procedure and application rate.
 2. Placement
 - a. Overlap prefabricated membrane strips at least 4 inches or as required by the Manufacturer.
 - b. Place joints in a shingling effect so water will drain effectively.
 3. Bonding
 - a. Use hand rollers or other satisfactory pressure apparatus on the membrane to assure firm and uniform contact with the primed surfaces.
 - b. Use a wide tipped torch to cause tackiness if an adhesive is required to create a good seal at joints.
 4. Placement
 - a. Place the membrane on the vertical face of the concrete curb to the height of the finished overlay surfacing plus 1 inch.
 5. Defects
 - a. Protect the entire membrane from developing wrinkles, air bubbles, or other placement defects.
 - b. Patch any torn or cut areas and narrow overlaps using a satisfactory adhesive and a piece of membrane.
 - c. Extend the patch at least 4 inches beyond any defect.
 - d. Bond the patch firmly to the surface.
 6. Traffic
 - a. Allow only necessary rubber tire vehicles on the membrane.
 - b. Do not allow public traffic.
 - c. Maintain the membrane in good condition until covered with pavement.
 7. Preparation for Overlaying
 - a. Apply a bond coat of an acceptable adhesive to the surface of the membrane if required by the membrane manufacturer.

3.3 ASPHALT SURFACING OVERLAY

- A. Do not place overlay surfacing until the Engineer has inspected the membrane and authorization has been granted.
- B. Do not place the overlay surfacing until the membrane has cured according to manufacturer's recommendations.
 - 1. Deposit, spread, and roll asphalt material so the membrane will not be damaged.

END OF SECTION

SECTION 07921

SEALING EXISTING CONCRETE SLOPE PROTECTION JOINTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sealing grooves, joints, and cracks for existing concrete slope protection.

1.2 RELATED SECTIONS

- A. Section 03152: Concrete Joint Control

1.3 REFERENCES

- A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation
- B. ASTM D 545: Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

- A. Manufacturer's product data and recommended installation instructions for all materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Backer Rod
 - 1. Size the diameter of the backer rod to be a minimum of ¼ inch larger than the widest point of the joint opening.

2. Use a closed cell foam expansion joint filler.
 - a. Meets the physical properties in Table 1 using test method ASTM D 545 utilizing a 2 inch backer rod specimen.

Table 1

Backer Rod Properties	
Physical Property	Requirement
Density	2.0 lb/ft ³ , minimum
Tensile Strength	25 psi, minimum
Compression	5 psi at 25%, minimum
Water Absorption	0.03 g/cm ³ by weight, minimum (1% maximum)
Temperature at 410° F	No Melting

- B. Rigid Plastic Foam
 1. Refer to ASTM C 578
 2. Type 9, density of 2 lb/ft³
- C. Joint Sealer (Structures) – Refer to Section 03152.

PART 3 EXECUTION

3.1 GROOVE, JOINT, AND CRACK LOCATIONS

- A. Mark the limits of all grooves, joints and cracks in the presence of the Engineer. This applies to all grooves, joints, and cracks that require sealing.
 1. Seal cracks $\frac{1}{8}$ inch and larger.

3.2 PREPARE GROOVES, JOINTS, AND CRACKS

- A. Remove the existing joint or groove material and all other debris from the designated grooves, joints, and cracks. Remove curing compounds, oil, grease, dirt, moisture, and any other foreign materials from the groove, joint, or cracked concrete surfaces by sandblasting.

3.3 SEAL GROOVES, JOINTS, AND CRACKS

- A. Use a backer rod when the joint width is equal to or greater than $\frac{3}{8}$ inch.
- B. Seal the grooves, joints, and cracks as field marked.
- C. Seal horizontal grooves, joints and cracks by starting at one side and proceed to the other side.

- D. Seal vertical grooves, joints, and cracks from the top to bottom.

3.4 SEAL WINGWALLS AND BACKWALL JOINTS

- A. Place the rigid plastic foam against the surface of all structural members before placing the joint sealant.
- B. Anchor the rigid plastic foam in place with a compatible adhesive.
- C. Recess the rigid plastic foam $\frac{3}{8}$ inch in the joints so a groove is formed above the rigid plastic foam filler.
- D. Fill the recess above the rigid plastic foam with sealant so the joint is sealed over completely.

3.5 PLACE SEALANT

- A. Place with a hand or power operated caulking gun after placing the backer rod.
- B. Tool the sealant using a concave pointing tool with soap solution.
- C. Do not place sealant unless temperature is at least 50 degrees F and rising.
- D. Finish sealant in a neat and clean fashion.
 - 1. Verify there are no irregular surfaces including peaks and valleys.
 - 2. Remove sealant outside of the joint.

END OF SECTION

SECTION 09972

PAINTING FOR STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prepare and paint all surfaces except where indicated otherwise.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM D 4285: Indicating Oil or Water in Compressed Air
- B. ASTM D 4417: Field Measurement of Surface Profile of Blast Cleaned Steel
- C. ASTM E 11: Wire Cloth and Sieves for Testing Purposes
- D. American Institute of Steel Construction (AISC)
- E. Federal Standards
- F. Mine Safety and Health Administration (MSHA) Standards
- G. National Institute for Occupational Safety and Health (NIOSH) Standards
- H. Northeast Protective Coating Committee (NEPCOAT)
- I. The Society for Protective Coatings (SSPC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Materials
 - 1. Source and gradation of the blast abrasive.
 - 2. Type and source of solvent if required.
 - 3. Manufacturer's information regarding the specified coating materials, including:
 - a. Required wet and dry film thickness
 - b. Project safety data
 - c. Thinning recommendations

- d. Temperature requirements
 - e. Profile recommendations
 - f. Mixing and application procedures
 - g. Required equipment
 - h. Method of application
 - 4. Test samples. Refer to this Section, article 1.6.
- B. Qualifications, methods, and documentation.
- 1. Certifications before the preconstruction meeting. Refer to this Section, article 1.7.
 - 2. Detailed plan of protection methods that includes Environmental Protection for approval.
 - 3. Quality Control Plan that contains at a minimum procedures and verification of the following:
 - a. Compression air check
 - b. Dry film thickness – Refer to SSPC-PA 2
 - c. Air temperature
 - d. Humidity and dew point
 - e. Surface temperature
 - f. Abrasive cleanliness check – Refer to SSPC-AB 2
 - g. Degree of cleanliness achieved
 - h. Surface profile – Refer to ASTM D 4417 method C
 - i. Batch number and amount of thinner used
 - j. Batch number of paint used
 - k. Mixing procedures
 - l. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags
 - 4. Daily reports upon request.
 - a. Submit no later than 24 hours following the completion of work.

1.6 TEST SAMPLES

- A. Department tests paint samples from each batch or lot before use.
- 1. Submit samples for verification.
 - 2. Paints must match the spectrum samples on file with the Department

1.7 PAINTER AND SANDBLASTER QUALIFICATIONS

- A. Contractors and subcontractors performing surface preparation or coatings applications in the field.
 - 1. Must have SSPC-QP 1 certification before the preconstruction meeting.
 - 2. Remain certified for the duration of the project.
- B. Contractors, subcontractors, and fabricators performing shop surface preparation or coatings applications.
 - 1. AISC-420-10/SSPC-QP 3 enclosed shop certification before the preconstruction meeting.
 - 2. Remain certified for the duration of the project.
 - a. Do not perform work if certification has expired.
 - 3. Notify the Department of any change in certification status.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Select a complete three-part coating system consisting of a zinc primer, epoxy or urethane intermediate coat, and aliphatic urethane top coat from the NEPCOAT Qualified Products List. Refer to <http://www.udot.utah.gov/go/standardsreferences>.
- B. Use paint color No. 26293 for the first field coat and No. 26306 for the top coat following Federal Standard 595.

PART 3 EXECUTION

3.1 GENERAL

- A. Use manufacturer's information regarding the specified coating materials including required wet and dry film thickness, project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.

3.2 INSPECTION

- A. Engineer examines surfaces before surface preparation and before application of each succeeding coating. Correct any condition that is determined by the Engineer to negatively affect a proper coating application.

- B. Provide safe access to permit inspection of the steel before and after painting. Use rubber rollers or other approved protective devices for scaffold fastenings. Do not mar or damage freshly coated surfaces.

3.3 PREPARE SURFACES

- A. Painted steel – Clean surfaces with clean petroleum solvents and then blast clean to a near-white condition following SSPC-SP 10. Use clean oil-free air.
 - 1. Grind off all fins, tears, slivers, and burred or sharp edges present on any steel member or those that result from the blasting operation.
 - a. Reblast where needed.
 - b. Remove all mill scale.
 - c. Do not scar metal.
 - d. Grind the edges of all flame cut steel until the hardened edge accepts the blast profile. Refer to ASTM D 4417 method A.
 - e. Produce a 0.5 - 3 mils uniform profile not to exceed manufacturer's recommendation.
 - 2. Remove all abrasive and paint residue using either a commercial vacuum cleaner or by double blowing.
 - a. Equip commercial vacuum cleaner with a brush-type cleaning tool.
 - b. Double blowing – Vacuum the top surfaces of all structural steel, including items such as top and bottom flanges, longitudinal stiffeners, splice plates, and hangers after the double-blowing operations are completed.
 - 3. Keep the steel dust free and prime within 8 hours after cleaning. Reblast to a near-white condition if any rust is visible before priming.
 - 4. Protect freshly coated surfaces from subsequent blast-cleaning operations.
 - a. Repair surface if damaged.
 - b. Mask all areas requiring field welding before shop painting.
 - 5. Have the surfaces inspected and approved by Engineer or Construction and Materials Division representative of Department before applying shop coat.
 - 6. Apply the shop coat at the fabrication site. Apply coatings at the fabrication site in an enclosure with a controlled environment to match optimum conditions for application and curing as stated in the manufacturer's product data sheet.
 - 7. Apply mist coat to the top flange.

- B. Field Painting
 - 1. Repair all damage to shop coat that occurs during shipping, handling, and erection.
 - 2. Power wash steel without the field coat to remove contaminants or other foreign matter from the primed surface.
 - 3. Blast clean bolt heads, fasteners, and any rusted areas to a near-white finish. Thoroughly clean the coating surrounding the blasted area and re-prime the same day using organic zinc from the same paint manufacturer and the same dry film thickness specified for the shop coat. Follow SSPC-SP 10.
 - 4. Remove all concrete drippings, abrasive, and paint residue. Vacuum items such as the top and bottom flanges, splice plates, longitudinal stiffeners, and hangers after completing double-blowing operations.
 - 5. Allow the touch-up coat to dry according to manufacturer's recommendation as listed on the product data sheet.

3.4 PREPARE PAINT MATERIALS

- A. Mix and thin paint materials according to manufacturer's product data sheets for both shop and field painting.
- B. Mix the paint to a lump-free consistency with a high shear mixer such as a Jiffy mixer according to the manufacturer's directions.
 - 1. Do not use paddle mixers or paint shakers.
 - 2. Keep paint in the original containers.
 - 3. Mix until all the metallic powder or pigment is suspended and until all paint solids that may have settled to the bottom of the container are thoroughly dispersed.
- C. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve according to the material standard. Refer to ASTM E 11.
- D. Strain and continuously agitate the mixed material up to and during application.

3.5 APPLY PAINT

- A. Apply field coats at the construction site after steel erection work is completed.
 - 1. Do not apply field coats until Engineer verifies the surface.
 - 2. Dry film thickness of the first field coat must be greater than 4 mils.
 - 3. Keep the dry-film thickness of the top coat greater than 2 mils.

- B. Use wet and dry film thickness gauges for testing the coating thickness during and after application.
- C. Apply each coat at required consistency and thickness according to the manufacturer's recommendations including field coating. Use pressures recommended by the manufacturer of the coating system when using spray nozzles.
- D. Produce a uniform, even coating that bonds to the underlying surface. Refer to SSPC-PA 1.
- E. Weather
 - 1. Follow the manufacturer's recommendations if weather conditions require paint thinning.
 - 2. Temperature of the air and the steel must be above 40 degrees F, but not so hot as to cause the paint to blister.
 - 3. Relative humidity must be less than 85 percent or the combination of temperature and humidity conditions must inhibit surface condensation.
 - 4. Test humidity by applying a thin film of water to a small area. Surface may be painted if the film evaporates within 15 minutes.
 - 5. The steel temperature must be a minimum of 5 degrees F above the dew point.
- F. Use necessary equipment for the proper application of the specified coating. Observe safety practices found in SSPC-PA Guide 10, "Guide to Safety and Health Requirements."
- G. Blast clean any shop coat that shows any indication of "mud-cracking" or adds more than 7 mils to a soundly bonded coating or bare steel. Refer to SSPC-SP 10.
- H. Thoroughly clean areas that have deficient primer thickness to remove all dirt.
- I. Apply an intermediate and top coat to any surface at the fabrication site that will be inaccessible for painting after field erection.
- J. Do not load structural steel for shipment until shop paint is dry to the touch.
- K. Protect all paint systems. Place softeners between plates of cross frames and diaphragms.

3.6 PROTECTION

- A. Stop work if protection is unsatisfactory.
- B. Protect pedestrian and vehicular traffic.
- C. Protect all portions of the structures that are not to be painted from splatter, splashes, and overspray including superstructure, substructure, slope, and highway appurtenances. Protect areas during painting and blast cleaning operations where other damage can occur.
- D. Use barriers during any blast-cleaning operations to protect pedestrians and vehicles and to prevent spreading or falling of abrasive materials and debris on the traveled portions of the pavement. Remove any abrasive materials and debris on pavement, shoulders, or slope paving before reopening work areas to traffic.
- E. Provide employees performing the blast-cleaning operations air-supplied blasting hoods approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health.
- F. Minimum requirements for the air supply system:
 - 1. Airline filter, pressure-reducing valve with gauge and pressure release valve.
 - 2. Do not allow the air supply to be contaminated with harmful materials or elements. Refer to ASTM D 4285.

3.7 QUALITY ASSURANCE

- A. Minimum Coating Thickness – Apply two or more coats if the required film thickness cannot be obtained by one coat without producing runs, bubbles, or sags.
- B. Refer to SSPC PA 2.

END OF SECTION

SECTION 09981

CONCRETE COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water repellant and tinted concrete sealer applied to concrete surface.
- B. Tinted concrete sealer reapplied over graffiti.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM D 3960: Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- B. ASTM D 4260: Liquid and Gelled Acid Etching of Concrete
- C. ASTM D 4262: pH of Chemically Cleaned or Etched Concrete Surfaces
- D. ASTM D 4263: Indicating Moisture in Concrete by the Plastic Sheet Method

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Materials
 - 1. Manufacturer's product data and recommended installation instructions for each product used.
 - 2. A one quart sample for testing, manufacturer's certificate of compliance, and laboratory test results using infrared techniques for each material proposed for use.
 - 3. Three 8½ inch by 11 inch samples of each concrete coating color required on the project for approval before ordering concrete coating materials.
- B. Weather Deviation for review
 - 1. Letter from the manufacturer stating the range of temperature and humidity requirements required for application of the product.
 - 2. All equipment and materials required.

1.6 FIELD EVALUATION

- A. Apply the full color palate to one area of the concrete to be coated for approval of the color scheme before the full application of the concrete coating system.

PART 2 PRODUCTS

2.1 CONCRETE COATING SYSTEM

- A. Water Repellent – Use a clear penetrating water repellent as a base coat as described. The water repellent coat must be compatible with the concrete sealer.
 - 1. Meet VOC content of 100 g/L or less. Refer to ASTM D 3960.
- B. Tinted Concrete Sealer – Use a high silicone content acrylic concrete sealer that provides a durable, opaque, deep penetrating, water repellent, decorative finish to concrete and masonry surfaces.
 - 1. Tint the concrete sealer to provide the colors as described.
 - 2. Meet VOC content of 250 g/L or less. Refer to ASTM D 3960.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only one concrete coating system on an individual structure.
- B. Furnish, prepare, apply, cure, and store all materials according to the product manufacturer's directions and as specified in this Section.
 - 1. Do not freeze material subjected
 - 2. Deliver concrete coating materials to the project site in sealed containers bearing the manufacturer's original labels with the brand, color, and type clearly marked on each container.
- C. Apply the water repellent and tinted concrete sealer to the concrete surfaces shown.

3.2 CONCRETE SURFACE PREPARATION

- A. Finish minor defects to blend with the balance of the textured surfaces.
 - 1. Repair visible vertical or horizontal seams or conspicuous form marks to the satisfaction of the Engineer.
- B. Cure all new concrete surfaces a minimum of 28 days before applying coating.
 - 1. Cure 14 days as an alternate to 28 days if the concrete has a pH level of 9 or lower according to ASTM D 4262 and no surface moisture according to ASTM D 4263. Test concrete surface for pH and surface moisture in four locations as directed by the Engineer.
 - 2. Cure concrete patches a minimum of seven days before being coated.
 - 3. Meet manufacturer's requirements.
- C. Clean the concrete surface to be coated by pressure washing.
 - 1. Use a minimum water pressure of 3,000 psi at a flow rate of 3 to 5 gal/min.
 - 2. Use a fan nozzle held perpendicular to the surface at a distance of 12 inches to 24 inches.
 - 3. Prevent overblasting, exposing additional air pockets, disfiguring the surface, or reducing architectural surface textures.
 - 4. Clean the final concrete surface to be free from release agents, grease, dirt, and any other contaminants. Remove curing compounds that deter penetration of the coating system.
 - 5. Rinse with potable water if detergents or de-greasers are used in the cleaning process.
- D. Perform pH test according to ASTM D 4262 before coating concrete surfaces.
 - 1. Add acid-etch to the power wash stream to reduce the pH if the pH exceeds 9, refer to ASTM D 4260. Rinse acid-etched surfaces with potable water no sooner than one hour after acid etch application and before re-testing the pH level.
 - 2. Repeat process until the pH level does not exceed 9.
 - 3. Do not perform pH test when applying coating over an existing coating.
- E. Perform chloride test using Chlor*test by Chlor*Rid Company, SCAT test by KTA Tator, or approved equal.
 - 1. Add a salt remover to the power wash stream to reduce the chloride level and retest the surface if the chloride level exceeds 50 ppm.

2. Repeat the process until the chloride level does not exceed 50 ppm.
- F. Comply with the manufacturer's recommendations for surface preparation.

3.3 COATING SYSTEM APPLICATION – GENERAL

- A. Do not apply the coating if the surface is wet due to rain or other precipitation.
1. Allow all wet surfaces at least 24 hours to dry before coating.
- B. Do not apply if rain is expected within 12 hours following application.
- C. Coat only when the outside air temperature will remain between 50 and 90 degrees F during and for at least 4 hours after application.
1. Obtain authorization for a Weather Deviation for temperatures outside of this range.
- D. Re-clean contaminated surfaces as defined in this Section, article 3.2 before the application of the next coat if surface becomes contaminated between coats.
- E. Stir the coating materials thoroughly before and during application.
- F. Reduce pressure to prevent atomizing of product, which causes dry spray when applying the coating by spray application.
1. Use a sprayer with a 0.013 to 0.017 inch tip opening or as recommended by the manufacturer.
 2. Spray from multiple angles to ensure that all surface texture impressions are covered.
 3. Spray upper areas from raised platforms.
- G. Protect coated surfaces from damage or detrimental elements during drying and curing.

3.4 WATER REPELLENT APPLICATION

- A. Apply water repellent when shown or specified.
- B. Water repellent is a base coat under two coats of concrete sealer.
- C. Follow manufacturer's recommendations for temperature requirements, application rate, equipment, and any other requirements for application.

- D. Thoroughly cure the water repellent a minimum of 24 hours or as recommended by the manufacturer before applying the tinted concrete sealer.

3.5 TINTED CONCRETE SEALER APPLICATION

- A. Apply a minimum of two coats of the tinted concrete sealer.
 - 1. Apply the first coat evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in one direction.
 - 2. Cure the first coat of the tinted concrete sealer a minimum of 3 hours or as recommended by the manufacturer before the second coat of the tinted concrete sealer is applied.
 - 3. Apply the second coat evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in the opposite direction of the first coat.
- B. Remove graffiti on previously coated areas by applying the tinted concrete sealer over affected area. Apply multiple coats as determined by the Engineer to completely cover the graffiti.
 - 1. Evenly apply the tinted concrete sealer at an application rate of 1 gal sealer/350 to 400 sq ft.
 - 2. Use the same color as the original application.
- C. Dilute the tinted concrete sealer with Xylene at a rate of 8 gal/drum or approximately 15 percent when applying the first coat over smooth dense (steel formed) vertical surfaces.
 - 1. Do not dilute on more porous concrete or when applying the second coat.
- D. Comply with the manufacturer's recommendations for application.

3.6 FIELD INSPECTION

- A. Do not apply any coat until the Department has verified compliance with manufacturer's recommendations and this specification.
- B. Use rubber rollers or other approved protective devices on scaffold fastenings.

3.7 PROTECTION FROM WORK

- A. Protect all surfaces that are not to be coated, including structures, slopes, and highway appurtenances, from splatter, splashes, and overspray or when damage during power washing and coating operations may occur.
- B. Protect all citizens and private property from splatter, splashes, and overspray, including but not limited to buildings, pedestrians, and vehicles.
 - 1. Prevent materials and debris from spreading or falling on the traveled portions of the pavement.
- C. Suspend work if protection is unsatisfactory.
- D. Remove any abrasive material and debris deposited on the structure, pavement, shoulders, or slope protection before reopening work areas to traffic.

3.8 CLEAN UP

- A. Follow the manufacturer's recommendations for cleaning spills and spatters.
- B. Follow all federal, state, and local laws for hazardous material cleanup and disposal.

3.9 SAFETY PRECAUTIONS

- A. Follow safety precautions according to manufacturer's product data sheets and Material Safety Data Sheet.

END OF SECTION

SECTION 09991

CLEANING AND REPAINTING OR OVERCOATING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning and repainting or overcoating existing structural steel surfaces including all bearing units.
- B. Removal of existing paint from existing structural steel surfaces.
- C. Preparation of existing steel surface for repainting or overcoating and painting the cleaned structural steel surfaces.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM D 3359: Measuring Adhesion by Tape Test
- B. ASTM D 4285: Indicating Oil or Water in Compressed Air
- C. ASTM D 4417: Field Measurement of Surface Profile of Blast Cleaned Steel
- D. ASTM D 4541: Pull-Off Strength of Coatings Using Portable Adhesion Testers
- E. ASTM E 11: Wire Cloth and Sieves For Testing Purposes
- F. Code of Federal Regulations (CFR)
- G. Federal Standards
- H. Northeast Protective Coatings Committee (NEPCOAT)
- I. The Society for Protective Coatings (SSPC)

1.4 DEFINITIONS

- A. Overcoating – Spot paint areas with bare steel followed by two coats of paint over the entire surface of each structural steel member.

1.5 SUBMITTALS

- A. Materials
 - 1. Source and gradation of the blast abrasive.
 - 2. Type and source of solvent if required.
 - 3. Manufacturer's information regarding the specified coating materials, including:
 - a. Required wet and dry film thickness
 - b. Project safety data
 - c. Thinning recommendations
 - d. Temperature requirements
 - e. Profile recommendations
 - f. Mixing and application procedures
 - g. Required equipment
 - h. Method of application
 - 4. Test samples
 - a. Cleaning operation samples, disposal evaluation results, and disposal certificates. Refer to this Section, article 3.2 paragraph C.
 - b. Samples to the Department and an independent accredited Materials Testing Lab for composition and disposal evaluation. Refer to this Section, article 1.6.
 - c. Paint composition and disposal evaluation results from the independent materials testing lab.
 - 1) Disposition will be given to the contractor within 30 days.
 - d. Disposal certificates for all waste paint.
- B. Qualifications, methods, and documentation for information.
 - 1. Certifications before the preconstruction meeting. Refer to this Section, article 1.7.
 - 2. Detailed plan of protection methods that includes Environmental Protection for approval.
 - 3. Quality Control Plan that contains at a minimum procedures and verification of the following:
 - a. Compression air check
 - b. Dry film thickness – Refer to SSPC-PA 2
 - c. Air temperature
 - d. Humidity and dew point
 - e. Surface temperature
 - f. Abrasive cleanliness check – Refer to SSPC-AB 2
 - g. Degree of cleanliness achieved
 - h. Surface profile – Refer to ASTM D 4417 method C
 - i. Batch number and amount of thinner used
 - j. Batch number of paint used

- k. Mixing procedures
 - l. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags
 - 4. Written site specific compliance program documenting the equipment, training, containment, and monitoring system to comply with OSHA's standard on lead exposure in construction as published in Federal Register, Section 29 CFR 1926.62, May 4, 1993.
 - a. Worker Health and Safety Program
 - b. Environmental Protection and Monitoring Program
 - c. Hazardous Waste Handling and Reporting of Release Program
 - d. Refer to SSPC Guide 6 – Guide for Containing Surface Preparation Debris
 - 5. Daily reports upon request.
 - a. Submit no later than 24 hours following the completion of work.

1.6 TEST SAMPLES

- A. Department will test paint samples from each batch or lot before use.
 - 1. Submit samples to the Engineer.
 - 2. Paints must match the spectrum samples on file with the Department.

1.7 PAINTER AND BLASTER QUALIFICATIONS

- A. The entity performing surface preparation or coatings applications in the field:
 - 1. Must have SSPC-QP 2 Category A certification before the preconstruction meeting.
 - 2. Remain certified for the duration of the project.
 - a. Do not perform work if certification has expired.
 - 3. Notify the Engineer of any changes in certification status.

PART 2 PRODUCTS

2.1 SOLVENT

- A. Solvent – Recommended by the paint system manufacturer.

2.2 COATING SYSTEM

- A. Select a complete three-part coating system consisting of a zinc primer, epoxy or urethane intermediate coat, and aliphatic urethane top coat from the NEPCOAT Qualified Products List. Refer to <http://www.udot.utah.gov/go/standardsreferences> for a link to this list.
- B. Paint Color – Federal Standard 595.
 - 1. Intermediate coat Color No. 26293
 - 2. Top coat Color No. 26306 or as specified

PART 3 EXECUTION

3.1 GENERAL

- A. Use manufacturer's information regarding the specified coating materials, including required wet and dry film thickness, project safety data, thinning recommendations, temperature requirements, profile recommendations, mixing and application procedures, and required equipment.

3.2 PREPARATION – GENERAL

- A. Meet soluble salts requirements of SSPC-Guide 15 and the coatings manufacturer.
- B. Protection
 - 1. Fully contain all material resulting from surface preparation and paint overspray.
 - 2. Enclosure system must withstand extreme high winds.
 - 3. Protect all portions of the structure that will not be painted.
 - 4. Protect pedestrian and vehicular traffic. Use barriers during any blast-cleaning operations to protect pedestrians and vehicles and to prevent spreading or falling of abrasive materials and debris on the traveled portions of the pavement. Remove any abrasive materials and debris on pavement, shoulders, or slope paving before reopening work areas to traffic.

- C. Recover a minimum of 95 percent of debris from cleaning operation.
 - 1. Sample debris from cleaning operation.
 - 2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.
 - 3. Dispose of waste paint as determined by the Engineer.

3.3 PREPARATION – REPAINTING STRUCTURAL STEEL

- A. Clean surfaces including bearing units of all oil, grease, and dirt with clean petroleum solvents or steam cleaning before blasting operation.
- B. Blast surfaces clean to near white with 0.5 to 2 mil profile. Refer to SSPC-SP 10.
- C. Discoloration, light shadows, or slight streaks caused by stains of rust is not allowed on more than 5 percent of surface area.
- D. Define acceptable surface preparation using SSPC-Vis 1.
- E. Use SSPC-SP 11 to clean areas such as backside of base plates and corners that cannot otherwise be cleaned.
- F. Prime the surface within 8 hours after blasting.
- G. Do not prime the surface if rust has started to form. Clean the surface again before applying the prime coat.

3.4 PREPARATION – OVERCOATING STRUCTURAL STEEL

- A. Clean designated surfaces of all oil, grease, debris, and dirt with clean petroleum solvents. Follow with high-pressure wash (SSPC-SP 1).
- B. Remove all corrosion and all paint that shows peeling, brittleness, checking, scaling, or general disintegration including bearing units.
 - 1. Use vacuum shrouded power tool cleaning (SSPC-SP 3).
 - 2. Remove paint from the area and beyond the edges of the area so that remaining paint system shows no rusting or blistering underneath and adheres tightly to the surface. Remaining paint system should have sufficient adhesion that cannot be lifted as a layer by inserting a blade or putty knife under it. Meet requirements of ASTM D 3359 and D 4541.
 - 3. Feather the edges of the remaining paint system around the cleaned areas so the repainted surface appears smooth.

3.5 PREPARE PAINT MATERIALS

- A. Mix the paint to a lump-free consistency with a high shear mixer according to the manufacturer's directions.
 - 1. Do not use paddle mixers or paint shakers.
 - 2. Keep paint in the original containers and mix until all the metallic powder or pigment is suspended.
 - 3. Continue mixing until all solids or pigments that may have settled to the bottom of the container are thoroughly dispersed.
- B. Strain the paint through a screen with openings no larger than those specified for a No. 50 sieve. Refer to ASTM E 11.
- C. Strain and continuously agitate the mixed material up to and during application.

3.6 APPLY PAINT – GENERAL

- A. Field Inspection
 - 1. Do not apply paint until the Engineer verifies the prepared surface.
 - 2. Use rubber rollers or other approved protective devices on scaffold fastenings.
 - 3. Do not use metal rollers, clamps, and other types of fastenings that mar or damage freshly coated surfaces.
- B. Consult with the manufacturer's technical representative for answers to technical questions related to the application of the specified coating materials.
- C. Project Conditions/Weather Limitations
 - 1. Follow the manufacturer's recommendations if weather conditions require paint thinning.
 - 2. Apply paint only when the following weather conditions exist:
 - a. The temperature of the air and the steel are above 40 degrees F but not so hot as to cause the paint to blister.
 - b. The relative humidity is less than 85 percent or such that the combination of temperature and humidity conditions inhibits surface condensation.
 - c. Apply a thin film of water to a small area to test humidity. The surface may be painted if the film evaporates within 15 minutes.
 - d. The steel temperature is a minimum of 5 degrees F above dew point.

- D. Use necessary equipment for proper application of the specified coating. Observe safety practices found in SSPC-PA Guide 10, Guide to Safety and Health Requirements.
- E. Apply paint with spray nozzles at pressures recommended by the manufacturer of the coating system.
- F. Use wet and dry film thickness gauges for testing the coating thickness during and after application. Refer to SSPC-PA 2. Use equipment capable of taking dry film thickness readings on all portions including nuts and bolts.
- G. Apply two or more coats if the required film thickness could not be obtained by one coat without producing runs, bubbles, or sags.
- H. Apply paint to produce a uniform, even coating that bonds to the underlying surface. Refer to SSPC-PA 1.

3.7 APPLY PAINT – REPAINTING STRUCTURAL STEEL

- A. Prime Coat
 - 1. Maintain the dry film thickness of the prime coat between 2.5 and 6.0 mils.
 - 2. Blast clean any coat that produces “mud-cracking” or adds more than 7.0 mils to a soundly bonded coating on bare steel. Refer to SSPC-SP 10. Re-coat the surface.
 - 3. Thoroughly clean areas that have deficient primer thickness with power washing equipment to remove all dirt. Wire-brush, vacuum, and re-coat the area.
- B. Intermediate Coat
 - 1. Use the coating type and minimum dry film thickness specified.
 - 2. Produce a dry-film thickness of the intermediate coat greater than 4 mils.
- C. Top coat – Keep the dry film thickness greater than 2 mils.

3.8 APPLY PAINT – OVERCOATING STRUCTURAL STEEL

- A. Intermediate Coat
 - 1. Spot paint any areas with bare steel, followed by another full intermediate coat over the entire steel surface.
 - 2. Apply a minimum dry film thickness of 3 mils for the spot coat and a minimum of 2 mils for the full intermediate coat.

- B. Top Coat
 - 1. Apply top coat to entire steel surface.
 - 2. Keep the dry film thickness at 2 mils or greater.

END OF SECTION

SECTION 13431

PRECAST CONCRETE FIBER OPTIC AND UTILITY VAULT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete fiber optic and utility vaults, and maintenance markers.
- B. Type IV-CV, and Type V-CV Precast Concrete Fiber Optic and Utility Vaults.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02221: Remove Structure and Obstruction
- C. Section 03575: Flowable Fill
- D. Section 13553: ATMS Conduit
- E. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO LRFD Bridge Design Specifications
- B. USDA Rural Utilities Service (RUS)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's shop drawings.
 - 1. Shop drawings must bear the seal of a Licensed Professional Engineer and will not deviate from the functional dimensions shown.
- B. Manufacturer's product specifications for information
- C. Manufacturer's warranty provisions

PART 2 PRODUCTS

2.1 FILL

- A. Free Draining Granular Backfill – Refer to Section 02056.
- B. Granular Backfill Borrow – Refer to Section 02056.
- C. Flowable Fill – Refer to Section 03575.
- D. Hand-mix grout
 - 1. Minimum strength – 50 psi
 - 2. Maximum strength – 150 psi
 - 3. Slump – 5 inches to 10 inches

2.2 FIBER OPTIC VAULTS AND COVERS

- A. Fiber vaults – pre-cast concrete. Refer to AT Series Standard Drawings for dimensions of vault types.
- B. Provide fiber vaults that are adjustable upwards to meet a new finished grade by the addition of manufacturer-provided risers, collars, or grade rings.
- C. Provide fiber vaults that have the cover frames cast separately from the vault structure and are removable and replaceable.
- D. Furnish an internal heavy-duty non-metallic cable storage rack system on two opposite fiber vault walls.
 - 1. Furnish and install two stanchions on each rack wall.
 - a. Fasten to the fiber vault wall according to the manufacturer's instructions.
 - b. Stanchions are a minimum of 36 inches for Type IV-CV fiber vault racks.
 - c. Stanchions are a minimum of 45 inches For Type V-CV fiber vault racks.
 - 2. Use cable rack arms that are appropriate for the amount of slack cable being installed but not be less than 4 rack arms in a Type IV vault and 5 rack arms in a Type V vault, capable of supporting a minimum of 250 lb.
- E. Supply Type IV-CV Fiber Optic and Utility Vaults with a hinged metal lid for unpaved areas or a heavy duty round manhole-style lid in paved areas.
 - 1. Supply Type V-CV vaults with a manhole-style lid only.

2. Fiber vaults with hinged metal lids will be rated for AASHTO LRFD HL – 93 loading according to AASHTO LRFD Bridge Design Specifications.
 3. Fiber vaults with round manhole style lids will be rated for AASHTO LRFD HL- 93 loading according to AASHTO LRFD Bridge Design Specifications.
- F. Provide hinged metal lids that have double-doors (split) and double hinges.
1. Provide a lid that operates freely over 180 degrees.
 2. Provide a lid with drop handles for easy opening.
 3. Provide a neoprene gasket between the hinged lid and the vault frame.
- G. Provide lids with a grounding lug with $\frac{1}{2}$ - 13 NC female threads on the underside of the manhole and hinged metal lids.
- H. Provide hinged and manhole lids with Penta-Head vandal resistant stainless steel bolts with washer.
1. All bolt holes must be self-draining.
- I. Furnish hinged metal lids that have a non-skid diamond pattern or similar surface that has a raised pattern of at least $\frac{3}{32}$ inch high.
- J. Provide lids for all vaults that are marked, "UDOT FIBER OPTIC" using a minimum 3 inch high letters with $\frac{1}{8}$ inch line thickness.
1. Form the letters by engraving, casting, stamping, or with a precise weld bead.
- K. Manhole Lid Access Points – recessed steel pull slots or holes to allow removal or opening of the manhole with a hook or lever.

2.3 MAINTENANCE MARKERS

- A. Furnish and install Utility Marker Posts for each vault location. Refer to AT Series Standard Drawings.

2.4 GROUND ROD

- A. Ground Rod - Refer to Section 16530.

2.5 WIRING

- A. Grounding Conductor – Refer to Section 16530.

2.6 LOCATE BALL OR DISK

- A. Place a locate ball or disk in each vault.
 - 1. Color – orange
 - 2. Requires no particular orientation when buried
 - 3. Place in bottom of each box
 - 4. Designed to last as long as the supplied vault
 - 5. Produces a uniform, spherical RF field in all directions
 - 6. Signal peak when directly over the ball
 - 7. Meets RUS Specifications

PART 3 EXECUTION

3.1 BACKFILL

- A. Place 12 inches of Free Draining Granular Backfill under vaults.
- B. Hand tamp Granular Backfill Borrow or approved native soil around the vault lid on unpaved surfaces.
 - 1. Match the top 6 inches to the composition, density, and elevation of the surrounding surface.

3.2 FIBER OPTIC AND UTILITY VAULT

- A. Install according to manufacturer's recommendations and AT Series Standard Drawings
- B. Core drill holes to match conduit entry where required without damaging the vault. Core drill holes at thin wall sections only. Do not "knock out" thin wall sections. Use grout to create a complete seal between conduit and the structure wall. Finish grout smooth and flush with the interior wall.
 - 1. Make core drilled holes in vault not more than ¼ inches larger than conduit diameter.
 - 2. Seal conduit and micro-duct ends inside all vaults with at least 2 inch thick duct seal after cables are installed.
 - 3. Seal vacant conduit and micro-ducts with a manufactured conduit plug and attach detectable pull tape. Refer to Section 13553.
- C. Install vault plum and level and grade backfill flush with vault.
- D. Do not locate fiber vaults on slopes or low lying locations with poor drainage.
- E. Do not install vaults within the traveled way or shoulders unless shown.

- F. Conduit in fiber vaults
 - 1. Install conduits into thin wall section only.
 - 2. Extend PVC conduit 2 inches, HDPE conduit 6 inches, micro-duct oversheath 6 inches and individual micro-ducts 2 ft beyond the inside wall of the vault.
 - 3. Align ATMS conduit ends by color at each side of the box.
 - 4. Install bushings on all conduits before cable installation according to Section 13553.
 - 5. Refer to AT Series Standard Drawings.
- G. Remove concrete sidewalk or other surfaces.
 - 1. Refer to Section 02221.
 - 2. Replace with in-kind materials to match the existing grade, texture, and color of concrete or other surface.
- H. Encase conduit in flowable fill or hand-mix grout where the conduit enters the fiber optic vault.

3.3 RESTORATION

- A. Restore areas disturbed or damaged during the installation of all vaults.

END OF SECTION

SECTION 13552

RAMP METER SIGNALS AND SIGNING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ramp Meter Signals and Signing including conduit, junction boxes, signing, mounting brackets, conductors, grounding, and foundations.
- B. State furnished items.

1.2 RELATED SECTIONS

- A. Section 02891: Traffic Signs
- B. Section 02892: Traffic Signal
- C. Section 03055: Portland Cement Concrete
- D. Section 03211: Reinforcing Steel and Welded Wire
- E. Section 13553: ATMS Conduit
- F. Section 13554: Polymer Concrete Junction Box
- G. Section 13555: ATMS Cabinet
- H. Section 13591: Traffic Monitoring Detector Loop
- I. Section 13595: ATMS Integration, Testing, and Acceptance
- J. Section 16530: Electrical Power

1.3 REFERENCES

- A. American Iron and Steel Institute (AISI)
- B. Underwriters Laboratories (UL)
- C. Utah Manual on Uniform Traffic Control Devices (UMUTCD)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Refer to Section 02892

PART 2 PRODUCTS

2.1 POLE FOUNDATION

- A. Provide a traffic signal mast arm pole foundation according to 02892 and the SL Series Standard Drawings.

2.2 RAMP METER MAST ARM SIGNAL ASSEMBLY

- A. 12-inch signal heads – Refer to Section 02892.
 - 1. Provide louvered back plate.
 - 2. Do not place retroreflective tape on backplate.
- B. RS10-29A “1 Vehicle Per Green Each Lane” and RS10-29B “2 Vehicles Per Green Each Lane” Signs: 48 inch x 36 inch. Refer to AT Series Standard Drawings.
- C. All signal head housings – Highway yellow with visor and back panels.
- D. Signal Pole – Refer to SL Series Standard Drawings.

2.3 RAMP METER ADVANCED WARNING

- A. Warning Sign – W3-8, 36 inch x 36 inch. Refer to Section 02891, MUTCD, and AT Series Standard Drawings.
- B. Traffic Signal Pole – Refer to Section 02892 and SL Series Standard Drawings.
- C. Use two “Z” bars on the back of the W3-8 sign to support against thrown snow. Refer to SN Series Standard Drawings.
- D. Install solid state flasher relay in the ATMS cabinet

2.4 BOLTS AND NUTS

- A. Refer to Section 02892.

2.5 CONDUCTORS

- A. Refer to Section 02892 for signal cable specifications.
- B. Refer to Section 16530 for power conductor specifications.

2.6 DETECTOR CIRCUIT

- A. Refer to Section 13591.

2.7 GROUND ROD

- A. Refer to Section 16530.

2.8 CONDUIT

- A. Refer to Section 16530.

2.9 POLYMER CONCRETE JUNCTION BOX

- A. Refer to Section 13554.

2.10 ATMS CABINET

- A. Refer to Section 13555.

2.11 MOUNTING BANDS AND BUCKLES

- A. American Iron and Steel Institute, (AISI) Type 201.
- B. Universal Mounting Brackets for Signals mounted on mast arm.

PART 3 EXECUTION

3.1 PREPARATION

- A. Load, transport, and install all State-Furnished materials according to the manufacturer's instructions and as shown in the contract.
- B. Provide foundations, junction boxes, ground rods, grounding lugs, conduit, signal heads, assemblies, and mounting devices, signs, and all additional equipment required for a complete and operational ramp meter system.

- C. Install all wiring, conduit, and junction boxes as shown in the contract. Refer to Sections 13553, 13554, 13555 and 16530.
 - 1. Protect existing conductors while installing new conductors.
- D. Connect the controller and all conductors as shown.
- E. Furnish and install all incidental items such as wire connectors, grommets, tape connectors, and electrical terminations necessary to make the ramp meter system complete.
- F. Clean equipment exterior of all rust and mill scale, dirt, oil, grease and other foreign substances after installation.

3.2 CONSTRUCT POLE FOUNDATION

- A. Refer to Section 02892

3.3 SIGNAL POLES

- A. Refer to Section 02892. Install the poles on new concrete bases. Apply rust, corrosion, and anti-seize protection to all threaded assemblies by coating the mating surfaces with an approved compound.
- B. Install pole with the hand hole facing away from traffic.
- C. Install ground rod according to the contract (NEC 250). Refer to Section 16530.
- D. All fasteners and attachment hardware for bands and other equipment must be stainless steel.
- E. Adjust the anchor bolt nuts, plumb all steel poles to the vertical with all signal heads and signs installed.
- F. Meet AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals for poles.

3.4 INSTALL WIRING

- A. Refer to Section 16530.
- B. Refer to Section 02892

- C. Mark cabinet cables with vinyl electrical color-coding tape as specified in Table 1. Refer to UL 510. Lanes numbered from inside shoulder to outside shoulder.

Table 1

Cables Marked with Colored Tape			
	Lane One	Lane Two	Lane Three
Ramp Meter Circuit	Blue	Red	Yellow
Detector Circuit	Blue	Red	Yellow
Advanced Warning Blankout	Blue and White	Red and White	Yellow and White

- D. Use Table 2 when connecting the conductors for ramp meter signal heads.

Table 2

Color-Coded Conductors	
	All Lanes
Ramp Meter Signal Circuit	White- Neutral Red- Red indicative Orange-Yellow indicative Green- Green indicative Blue- Enforcement (if present) or spare

- E. Use Table 3 and Table 4 for connecting conductors to terminals in the cabinet.

Table 3

T4	SP	Color	Lane
1	3-3	RED	3
2	3-5	YELLOW	
3	3-7	GREEN	
4	2-3	RED	2
5	2-5	YELLOW	
6	2-7	GREEN	
7	1-3	RED	1
8	1-5	YELLOW	
9	1-7	GREEN	
10	N/U	N/U	

Lane 1 is inside lane

Table 4

Terminal	SP	Color	Function
FT6-16	9	Green	Flashers solid output

3.5 RAMP METER SIGNAL ASSEMBLY SIGN

- A. Refer to Section 02892.

3.6 INSTALL SIGNAL HEADS

- A. Do not install signal heads until the system is ready for operation.
- B. Use louvered back plates on signal heads as shown. Use a minimum of four 0.12 inch stainless steel screws per section to mount the back plates or according to manufacturer's instructions.
 - 1. Do not place retroreflective tape on backplates.

3.7 INSTALL PREFORMED DETECTOR LOOPS

- A. Refer to Section 13591.
- B. Refer to AT Series Standard Drawings for detection locations.

3.8 ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

- A. Follow the integration, inspection, testing, and acceptance process according to Section 13595.

END OF SECTION

SECTION 13553
ATMS CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. ATMS conduit for communications and fiber optic cables.
- B. Detectable pull tape, conduit, and all materials, labor, workmanship, equipment, and incidental items required for a complete system of conduit.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02221: Remove Structures and Obstruction
- C. Section 02705: Pavement Cutting
- D. Section 02741: Hot Mix Asphalt (HMA)
- E. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork
- F. Section 02842: Delineators
- G. Section 03575: Flowable Fill

1.3 REFERENCES

- A. ASTM D 2241: Poly-Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- B. ASTM F 2160: Solid Wall High Density Polyethylene (HDPE) Conduit based on Controlled Outside Diameter (OD).
- C. National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA)
- E. State of Utah Administrative Rules
- F. Underwriters Laboratories (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and recommended installation instructions.
- B. Manufacturer's warranties and parts lists
- C. Conduit Mandrel Test Form prior to substantial completion.
- D. Refer to <http://www.udot.utah.gov/go/standardsreferences> for blank forms for this Section.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Conduit and fittings for ATMS communication and fiber optic conduit
 - 1. Schedule 40 PVC rated at 194 degrees F as specified in NEMA TC-2, NEMA TC-3, ASTM D 2241,
 - 2. High Density Polyethylene (HDPE) SDR11 rated complying with ASTM F 2160.
 - a. HDPE conduit with smooth outer wall and ribbed or smooth interior wall.
 - b. Fittings and couplers rated for a minimum of 130 psi.
 - c. Mechanical type couplers when joining HDPE and PVC conduits.
 - 3. Microduct
 - a. HDPE microduct with an outside/inside diameter of 0.500/0.394 inch (12.7/10 mm) or 0.630/0.512 inch (16/13 mm) or 0.709/0.551 (18/14 mm), as shown.
 - b. Microduct having a ribbed interior.
 - c. Watertight couplers rated for a minimum of 200 psi.
 - d. Microduct bundle within a single 0.100 inch thick polyethylene oversheath.
 - e. Microduct bundles must contain a factory installed #14 AWG solid, insulated locate wire and a minimum of two rip cords for removal of oversheath.
- B. Conduit Banks
 - 1. New, prefabricated
 - 2. ATMS Multi-duct Conduit Types
 - a. 1D = four 1.25-inch conduits

- b. 2D = eight 1.25-inch conduits
 - c. 4D = sixteen 1.25-inch conduits
 - 3. Color-code each conduit or cell as follows:
 - a. One, two, or three conduits gray
 - b. 1D Bank 1 blue, orange, green and brown
 - c. 2D Bank 1 blue, orange, green, and brown
Bank 2 slate, white, red, and black
 - d. 4D Bank 1 blue, orange, green, and brown
Bank 2 slate, white, red, and black
Bank 3 same as bank 1 with a contrasting stripe
Bank 4 same as bank 2 with a contrasting stripe
 - 4. Microduct types:
 - a. Individual 0.500/0.394 inch (12.7/10 mm) or 0.630/0.512 inch (16/13 mm) microducts installed loosely within new or existing conduit.
 - b. MD2, MD3, MD4 and MD7: microduct bundle containing two, three, four or seven 0.709/0.551 inch (18/14 mm) microducts respectively.
 - c. Factory-assembled bundles for bundled applications.
 - 5. Color-code microducts and oversheaths as follows:
 - a. Individual microducts installed loosely within conduit or bundled within oversheath:
 - 1) blue
 - 2) orange
 - 3) green
 - 4) brown
 - 5) slate
 - 6) white
 - 7) red
 - 8) black
 - b. Oversheaths:
 - Bundle #1 blue
 - Bundle #2 orange
 - Bundle #3 green
 - Bundle #4 brown
- C. Meet or exceed all of the conduit manufacturer's recommendations for materials used in the installation of conduits including sweeps, adapters, couplings, glue, plugs, and fittings.
- 1. Conduit plugs must seal the conduit and allow the secure fastening of detectable pull tape.
- D. PVC conduit sections – Nominal 20 ft sections. Couplings and fittings must provide watertight integrity.

- E. Sweeps – factory manufactured sweeps (11¼, 22½, 45, and 90 degree angles) complete with bell and spigot.
- F. Detectable Pull Tape – flat profile, low stretch polyester, detectable, sequential footage marked, 1,200 lb tensile strength pull tape in each conduit.
- G. Backfill
 - 1. Flowable Fill – Refer to Section 03575.
 - 2. Free Draining Granular Backfill – Refer to Section 02056.
 - 3. Sand
 - a. Friable natural river or bank aggregate, free of loam, detrimental, or soluble or organic matter.
 - b. ¾ inch minus, well graded.
 - 4. Hand-mix grout
 - a. Minimum strength – 50 psi
 - b. Maximum strength – 150 psi
 - c. Slump – 5 inches to 10 inches
- H. Rigid Metal Conduit (RMC) complying with UL-6. Zinc galvanized exterior coating complying with ANSI C80.1.
- I. Liquidtight Flexible Metal Conduit (LFMC), -30 degrees C to 80 degrees C rated, UL 360 listed.
- J. Liquidtight Flexible Nonmetallic Conduit (LFNC), 80 degrees C dry, 60 degrees C wet rated, sunlight resistant, UL 1660 listed.

PART 3 EXECUTION

3.1 GENERAL

- A. Maximum spacing between junction boxes and vaults
 - 1. 500 ft for electrical cable.
 - 2. 1,000 ft for fiber optic cable on tangent surface street installations.
 - 3. 2,500 ft for fiber optic cable on tangent highway installations.
 - 4. Reduce maximum spacing if horizontal or vertical deflection incurred during installation prevents the installation of cable within maximum pulling tension rating of the cable.
 - 5. Notify the Engineer if utility avoidance requires junction box and conduit locations differing from requirements for deflection in this Section, article 3.2.

- B. Minimum Cover of Conduit
 - 1. Minimum cover under pavement is 4ft and minimum cover under sidewalks is 3 ft.
 - 2. Minimum cover in highway right-of-way, greater than 20 ft from the edge of the pavement is 3 ft.
 - 3. Minimum cover in highway right-of-way, within 20 ft of the edge of the pavement is 5 ft.
 - 4. Refer to State of Utah Administrative Rule 930-7

3.2 INSTALLATION

- A. Prevent conduit from deflecting vertically or horizontally along its length by a ratio greater than 10:1, (no more than 4-inch deflection per 40 inch in length) when installing conduit that houses communication cable.
- B. Prevent sum total of the vertical and horizontal conduit deflection or bend between any two junction boxes from exceeding 270 degrees when installing conduit.
- C. Install conduit within 1 ft of existing parallel conduit run if the planned location of conduit is parallel to the existing traffic signal or ATMS conduit.
- D. Obtain approval for field bending of conduit with the Engineer in cases where factory sweeps are not appropriate. Field bending must be performed using a heat box or heat blanket. Torch heating conduit is prohibited. Install all conduit bends to have a radius that is not less than the following:
 - 1. 24 inches within the cabinet and pole foundations
 - 2. 36 inches in all other locations
 - 3. 46 inches for MD7 microduct bundle
 - 4. 40 inches for MD4 microduct bundle
 - 5. 36 inches for MD3 microduct bundle
 - 6. 32 inches for MD2 microduct bundle
 - 7. 12 inches for individual microduct
- E. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, or textured or decorative surfaces by boring, jacking, or drilling. Replace any damaged concrete sections, joint to joint. Refer to Section 02221.
- F. Proof all conduit before installation of cabling and detectable pull tape.
 - 1. Use a mandrel at least 80 percent of the conduit diameter, at least twice as long as the conduit diameter, and composed of rigid material.
 - 2. Schedule proofing with the Engineer at least 5 working days in advance of performing the work.

3. Proof all conduit with a Department representative witness present.
 4. Complete and submit a completed Conduit Mandrel Test Form for all ATMS conduit.
 5. Proof microducts using proofing balls.
 6. Proofing balls must maintain a minimum 80 percent fill ratio of inside diameter of the microduct being tested.
 7. Proofing must occur after all junction boxes have been installed to final grade, including placement of flowable fill or hand-mix grout at junction box walls, and after all excavation in the immediate proximity of the conduit system has been completed.
 - a. Re-proof any conduit segment where excavation has occurred near the conduits following initial proof testing.
- G. Provide detectable pull tape in all conduits.
1. Install continuously between junction boxes.
 2. Fasten securely to conduit plug and leave 6 ft of pull tape slack inside of the conduit.
 3. Do not splice detectable pull tape in conduit.
 4. Use flat profile, low stretch polyester, 1,200 lb tensile strength detectable pull tape that is sequential footage marked.
 5. Verify that the pull tape is detectable throughout its entire length by performing a continuity test or equivalent verification.
 6. Detectable pull tape not required in microducts.
- H. Encase open trench conduit in sand backfill covered by flowable fill within existing roadway, proposed roadway and sidewalk pavement areas only.
1. Seal junction box wall around conduits using flowable fill or approved hand-mix grout.
 2. Use 12 inches of sand backfill covered with native material in all other areas.
 3. Refer to AT Series Standard Drawings.
- I. Use rigid metal conduit or schedule 80 PVC conduit for above ground application.
1. Liquidtight flexible metal conduit (LFMC) or liquidtight flexible non-metallic conduit (LFNC) is permitted in lengths not exceeding 6 ft where not subject to physical damage.
 2. Apply corrosion protection to any portion of rigid metal conduit buried in the ground or encased in concrete.
- J. Use PVC or HDPE conduit for underground application.
- K. Warning Tape
1. Install orange warning tape with black legend "Caution - Buried Communication Cable," in all trenches containing multi-duct conduit or conduit containing communication cables.

2. Install red warning tape with black legend "Caution - Buried Electric" in all other trenches.
 3. Not required when flowable fill is directly overlaid with asphalt pavement or PCCP.
 4. Not required when boring or plowing conduit.
- L. Install a bushing or adapter at ends of all conduits that contain a conductor according to the NEC.
- M. Furnish and install Utility Marker Posts along the longitudinal conduit running line. Refer to AT Series Standard Drawings and Section 02842.
- N. Install a #14 AWG solid, insulated locate wire inside of new or existing conduit with individual microducts.
1. Verify that all locate wires are detectable throughout their entire length by performing a continuity test or equivalent verification.

3.3 TRENCH

- A. Paved Asphalt Surface
1. Install T-patch over trenched area according to AT Series Standard Drawings.
 2. Cut pavement from roadway surface to roadway base on both sides of trench to provide a clean, straight wall for T-patch before any backhoe use according to Section 02705.
 3. Refer to AT Series Standard Drawings for depth of flowable fill under paved surfaces.
 4. Evenly apply tack coat on final backfill before installing T-patch.
 5. Place restoration patch – match the composition, density, and elevation ($\pm\frac{1}{4}$ inch), of the existing surface according to Section 02741.
 6. Apply a hot-pour rubberized asphalt joint sealant or approved equal after the patch is installed.
- B. Sidewalk or Decorative Pavement
1. Use flowable fill to bottom of new pavement or sidewalk.
 2. Match existing pavement thickness. New pavement thickness must be 3½ inches minimum and 8 inches maximum.
 3. Restore sidewalk or decorative pavement to original condition or better after work is completed. Refer to Section 02776.
- C. Unpaved Surface
1. Backfill using native material, if suitable, that matches the composition, density, and elevation (± 0.2 inch), of the existing surface according to Section 02056.
 2. Dispose of surplus material promptly.

- 3. Sand Backfill
 - a. Use sand backfill in trench sections outside of existing roadway, proposed roadway, and sidewalk pavement areas, including exposed conduit locations when plowing or boring.
 - b. Provide 12 inches of sand backfill above conduit in trench.
 - 1) Backfill trench above sand to finished grade using native material.
 - a) Backfill and tamp in 6 inch lifts.
 - c. Compaction of sand backfill is not required.
- D. Sleeve foreign utilities that cross a trench so they are not encased in flowable fill.
- E. Place all conduits in the same trench whenever possible.
- F. Flowable Fill or Hand-mix Grout
 - 1. Install flowable fill or approved hand-mix grout to the wall of junction box to seal conduit entry into junction box.
 - 2. Clean excess flowable fill or hand-mix grout from the inside of the junction box.
- G. Install all conduits so the flowable fill or sand backfill completely encases all exterior surfaces of the conduit.
 - 1. Separate multi-duct conduits using a commercially available conduit spacer or approved equivalent.
 - 2. Place spacers no more than 4 ft apart and not more than 2 ft from each coupler.
- H. Anchor the conduit in trench at 16 ft intervals to maintain the required conduit depth during flowable fill placement.
- I. Minimum separation between all conduits and the wall of the trench is 1½ inches.

3.4 BORE OR PLOW

- A. Immediately contain, remove, and properly dispose of all excess drilling fluid.

3.5 USE OF EXISTING OR OCCUPIED CONDUIT

- A. Maintain the physical condition and functional integrity of all cabling and wiring in existing or occupied conduit.
- B. Cable or wire installation in an existing or occupied conduit.
 - 1. Remove any existing fiber optic cable or copper wire.

2. Test the integrity and clean the conduit by successfully pulling a Department-approved mandrel through the conduit.
 3. Re-pull existing and new fiber optic cable or copper wire together.
 4. Perform all necessary splices and replace any impacted fiber cable and spider fan-out kits according to Section 13594.
- C. Use existing conduit in-situ only if shown and as approved by the Engineer.
- D. Intercept individual microducts from existing microduct bundle mid-span and reroute to new junction box location:
1. Type II-PC junction box
 - a. Bury at existing microduct bundle depth.
 - b. Notch the 24-inch box walls and install junction box over existing microduct bundle.
 - c. Provide 12 inches of free draining granular backfill borrow underneath junction box.
 - d. Encase all conduit in flowable fill or hand-mix grout where the conduit enters the junction box.
 - e. Place locate ball or disk in junction box.
 - f. Ground rod, and grout floor are not required.
 2. Conduit and microduct bundle inside of buried Type II-PC junction box.
 - a. Install conduit from buried junction box to new junction box location for rerouting of individual microducts. Provide #14 AWG solid, insulated locate wire inside of new conduit between junction boxes.
 - b. Extend conduit and microduct oversheath 6 inches beyond inside wall of the junction box.
 - c. Expose microducts by removing no more than 20 inches of oversheath.
 - d. Identify and cut only the individual microducts to be rerouted.
 - e. Use approved couplers and extend microducts to new junction box using corresponding microduct color.
 - f. Splice all locate wires together using an approved waterproof connector.
 - 1) Verify that the locate wire conductors are not exposed.
 3. New junction box location
 - a. Install new junction box within 20 ft of buried junction box or within 20 ft of edge of roadway when existing microduct bundle is underneath roadway, to provide access to locate wire for mapping and locating purposes.

3.6 REPAIR OR RESTORATION

- A. Restore all areas, including landscaping, concrete pavement, asphalt, finished curbs and gutters, box culverts, sewers, underground water mains, sprinkler systems, sidewalks, concrete flatwork, colored, textured, or decorative surfaces damaged during conduit and junction box installation.
- B. Coordinate with local utilities for utility repair.
- C. Notify the Engineer of all necessary repairs.
- D. Replace all damaged facilities in kind.
- E. Buried microduct bundle coupling and repair:
 - 1. Expose microducts by removing no more than 12 inches of oversheath beyond area to be coupled or repaired.
 - a. Trim microducts to length as necessary to eliminate all bends and deflection.
 - 2. Use approved couplers.
 - 3. Splice the locate wires together using an approved waterproof connector.
 - a. Verify that the locate wire conductors are not exposed.
 - 4. Protect exposed microducts, couplers and locate wire using split duct.
 - a. Seal split duct joints and split duct ends around microduct bundle oversheath using approved waterproof sealing tape or other approved methods prior to backfill.
 - b. Do not use heat-shrink or cold-shrink protection methods.

END OF SECTION

SECTION 13554

POLYMER CONCRETE JUNCTION BOX

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polymer concrete junction boxes, ground rods, and maintenance markers. Includes Type I, Type II, and Type III Polymer-Concrete Junction Boxes.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02221: Remove Structures and Obstruction
- C. Section 02842: Delineators
- D. Section 03055: Portland Cement Concrete
- E. Section 03152: Concrete Joint Control
- F. Section 03575: Flowable Fill
- G. Section 13553: ATMS Conduit
- H. Section 16530: Electrical Power

1.3 REFERENCES

- A. ASTM C 579: Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- B. ASTM C 580: Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- C. American National Standards Institute (ANSI)
- D. Society of Cable Telecommunications Engineers (SCTE) Standards
- E. USDA Rural Utilities Service (RUS) Specifications

1.4 DEFINITIONS

Not Used

1.5 SUBMITTALS

Not Used

PART 2 PRODUCTS

2.1 FILL

- A. Free draining granular backfill – Refer to Section 02056.
- B. Granular backfill borrow – Refer to Section 02056.
- C. Flowable fill – Refer to Section 03575.
- D. Hand-mix grout
 - 1. Minimum strength – 50 psi
 - 2. Maximum strength – 150 psi
 - 3. Slump – 5 inches to 10 inches

2.2 JUNCTION BOXES AND LIDS

- A. Junction boxes – pre-cast polymer concrete. Refer to AT Series Standard Drawings for dimensions of junction box types.
- B. Furnish boxes, rings, and lids that meet all the requirements of ANSI/SCTE 77, including Tier 22 loading.
- C. Use split lids with Type III-PC junction boxes.
- D. Use lids for all junction boxes specified by application.
 - 1. Manufacture lids with the following marking in the logo area, in 1 inch cast in place recessed letters:
 - a. “UDOT Fiber Optics” when the junction box contains only fiber optic cable or future use multi duct conduit.
 - b. Traffic Signal, Street Lighting, Electrical, Communications and Landscaping may also use this type of description as an alternative to using attached name plates.

2. Manufacture lids with a recessed area to accommodate name plates used for all other Traffic Signal, Street Lighting, Electrical, Communications, and Landscaping applications.
 - a. Attach name plates to each removable lid section as well as one to the inside wall of the junction box using adhesive and non-corroding screws. Use an adhesive that meets or exceeds the following criteria:
 1. Tensile Strength – 1200 psi
 2. Service temperature, cured – subzero to +140 F.
 3. Cure time – 24 hours
 - b. Insert two non-corroding tamper resistant screws after adhesive is cured.
 3. Determine the name plate description using the Junction Box Logo Decision Chart found on the UDOT Standards and Specifications References: <http://www.udot.utah.gov/go/standardsreferences>
- E. Lid Access Points – recessed reinforced steel pull slots rated for 3000 pounds to allow removal of cover with a hook or lever. Replace lid if damage occurs to the pulling point.
- F. Lid Bolt Holes – self draining.
- G. Bolts – Zinc plated recessed hex head coil bolts with washer. Refer to AT Series Standard Drawings.

2.3 UTILITY MARKER POST

- A. Furnish and install Utility Marker Posts for each junction box location. Refer to Section 02842 and AT Series Standard Drawings.

2.4 GROUND ROD

- A. Ground Rods – Refer to Section 16530.

2.5 WIRING

- A. Ground Conductor – Refer to Section 16530.

2.6 CONCRETE COLLAR

- A. Class AA(AE) concrete – Refer to Section 03055.

2.7 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint filler. Refer to AT Series Standard Drawings and Section 03152.

2.8 LOCATE BALL OR DISK

- A. Place a marker ball or disk in each junction box.
 - 1. Color – orange
 - 2. Requires no particular orientation when buried
 - 3. Place in bottom of each box
 - 4. Must produce a uniform, spherical RF field in all directions
 - 5. Signal peak when directly over the ball
 - 6. Meets RUS Specifications

PART 3 EXECUTION

3.1 BACKFILL

- A. Place 12 inches of free draining granular backfill under junction boxes.
- B. Compact granular backfill borrow or approved native soil around the junction box collar. Match the top 6 inches to the composition, density, and elevation of the surrounding surface.

3.2 JUNCTION BOX AND EXTENSION

- A. Install according to manufacturer's recommendations.
- B. Precast junction boxes with precast conduit holes or drill holes to match conduit entry where required without damaging the box. Use grout to create a complete seal between conduit and the junction box wall. Finish grout smooth and flush with the interior wall.
 - 1. Make drilled holes in junction box not more than ¼ inches larger than conduit diameter.
 - 2. Seal conduit and microduct ends inside all junction boxes with at least 2 inch thick duct seal after cables are installed.
 - 3. Seal vacant conduit and microducts with a manufactured conduit plug and attach detectable pull tape where applicable. Refer to Section 13553.
- C. Level the top of junction box and grade with positive drainage away from the box.

- D. Conduit in junction box
 - 1. Do not install conduit within 2 inches of junction box corner.
 - 2. Extend PVC conduit 2 inches, HDPE conduit 6 inches, microduct oversheath 6 inches and individual microducts 2 ft beyond the inside wall of the junction box.
 - 3. Align ATMS conduit ends by color at each side of the box.
 - 4. Enter conduit through the sides of the junction box and not from the bottom.
 - 5. Place the conduit in the bottom half of the junction box wall at least 3 inches above the floor.
 - 6. Install bushings on all conduits before cable installation according to Section 13553.
 - 7. Refer to AT Series Standard Drawings.
- E. Remove concrete sidewalk or other surfaces that require removal by saw cutting.
 - 1. Remove entire section of concrete, joint to joint. Refer to Section 02221.
 - 2. Replace with in-kind materials to match the existing grade, texture, and color of concrete or other surface.
- F. Install Engineer-approved ½ inch preformed expansion joint material around entire periphery of ring for junction boxes installed in paved surface.
- G. Encase all conduit in flowable fill or approved hand-mix grout where the conduit enters the junction box.
- H. Provide a cast-in-place 1 inch thick grout floor, with a 1 inch diameter drain at the low point, for all Type I, II, and III-Polymer Concrete Junction Boxes or provide a box with a prefabricated floor with a 1 inch drain hole. Use grout according to ASTM C 579 and ASTM C 580.
- I. Do not stack boxes.

3.3 CONCRETE COLLAR

- A. Refer to AT Series Standard Drawings.
- B. Concrete AA(AE) – Refer to Section 03055.
- C. Install concrete collars around junction boxes in all locations except where junction boxes are in concrete paved surfaces.

3.4 GROUND ROD

- A. Refer to Section 16530
- B. Attach splice enclosure to the ground rod with a ground conductor.

3.5 LOCATE BALL OR DISK

- A. Place locate ball or disk in each ATMS junction box.

3.6 RESTORATION

- A. Restore all areas damaged during the installation of the junction boxes at no additional cost to the Department.

END OF SECTION

SECTION 13555

ATMS CABINET

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of State furnished ATMS cabinets.
- B. Installation or modification of concrete foundations.
- C. Pedestal-mounted and pole-mounted cabinets.

1.2 RELATED SECTIONS

- A. Section 03055: Portland Cement Concrete
- B. Section 03152: Concrete Joint Control
- C. Section 03211: Reinforcing Steel and Welded Wire.
- D. Section 03310: Structural Concrete
- E. Section 13553: ATMS Conduit
- F. Section 13554: Polymer Concrete Junction Box
- G. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- C. ASTM B 633: Electro-deposited Coatings of Zinc on Iron or Steel
- D. National Electrical Manufacturers Association (NEMA)
- E. National Electrical Code (NEC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STATE FURISHED EQUIPMENT

- A. ATMS Cabinet
 - 1. Pedestal-Mounted Cabinet – NEMA 3R, 5052 aluminum control cabinet, 0.125 inch minimum thickness with the maximum dimensions of 66 inch H x 24 inch W x 22 inch D.
 - 2. Pole-Mounted Cabinet – NEMA 3S or better, 5052 aluminum control cabinet, 0.125 inch minimum thickness with the maximum dimensions of 36 inch H x 24 inch W x 22 inch D.

2.2 ATMS CABINET

- A. Provide and install fittings, flexible conduit, ground rods, ground wire, other materials, equipment, labor, and all incidental items necessary to construct a complete and operational ATMS cabinet.

2.3 CABINET FOUNDATION

- A. Concrete – Class AA(AE). Refer to Section 03055.

2.4 BOLTS, NUTS, AND HARDWARE

- A. Wedge expansion type or cast-in-place anchor bolts for cabinet mounts.
 - 1. $\frac{3}{4}$ inch x 8 inch expansion anchor bolts.
 - 2. 9,000 lb of pullout strength.
- B. Commercially available framing strut to attach transformers, breaker enclosures, disconnects, or other electrical equipment. Refer to AT Series Standard Drawings.
 - 1. 12 gauge, U-shaped stainless steel channel with $\frac{5}{8}$ inch diameter pre-drilled holes.
 - 2. Cross-section dimensions – $1\frac{5}{8}$ inch x $1\frac{5}{8}$ inch minimum.
- C. Wedge expansion anchor bolts to secure framing strut to foundation for framing struts.
 - 1. $\frac{1}{2}$ inch x 8 inch embedded a minimum of 6 inches in foundation.
 - 2. Shear capacity of 2,500 lbf and pullout tension capacity of 2,600 lbf.

- D. Stainless steel, galvanized, or zinc plated bolts, nuts, washers, struts, and hardware as described.
 - 1. Steel: Refer to ASTM A 307.
 - 2. Galvanized: Refer to AASHTO M 111.
 - 3. Zinc plated: Refer to ASTM B 633.
- E. Nuts that are free running by hand for total thread length.
- F. Bolted connections with lock washers, locking nuts, or other approved means to prevent the connection nuts from backing off.
- G. Nipples, elbows, and grommets necessary for wiring.

2.5 CONDUIT

- A. Refer to Section 13553.
- B. Refer to Section 16530.

2.6 POLYMER CONCRETE JUNCTION BOX

- A. Refer to Section 13554.

2.7 GROUND ROD

- A. Refer to Section 16530.

2.8 POWER SOURCE

- A. Refer to Section 16530.

2.9 TRANSFORMER AND DISCONNECT

- A. Refer to Section 16530.

2.10 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint filler. Refer to AT Series Standard Drawings and Section 03152.

2.11 CONDUCTORS

- A. Refer to Section 16530.

PART 3 EXECUTION

3.1 PREPARATION

- A. Contact the Engineer at least 14 calendar days to schedule pick up of State furnished equipment.
- B. Provide concrete maintenance pads when surrounding area is not paved. Refer to AT Series Standard Drawings.
 - 1. Verify maintenance equipment has full access to the site.
- C. Restore area to the original condition after construction is completed.

3.2 CONSTRUCT CABINET FOUNDATION

- A. Reinforcing Steel and Welded Wire. Refer to Section 03211.
- B. Verify bolt pattern, conduit runs, and foundation dimensions before foundation construction.
 - 1. Install anchor bolts to accommodate conduit runs.
 - 2. Embed strut anchor bolts a minimum of 6 inches into foundation.
 - 3. Embed cabinet anchor bolts a minimum of 6 inches into foundation.
- C. Concrete – Refer to Section 03055.
- D. Do not weld reinforcing steel, conduit, or anchor bolts.
 - 1. Use tie wire to secure conduits.
 - 2. Use template to align and secure anchor bolts.
 - 3. Locate steel, conduit, or anchor bolts a minimum of 3 inches from concrete surface.
- E. Place the concrete directly into the excavation. Refer to AT Series Standard Drawings.
- F. Extend conduit 2 inches above the floor of the cabinet foundation.
- G. Conduit
 - 1. Install all conduit in base of cabinet within a 12 inch x 18 inch rectangle centered in the cabinet base.
 - 2. Refer to AT Series Standard Drawings for number and type of conduit used between the cabinet and adjacent junction boxes.
 - 3. Install bushings on the ends of all conduit before cable installation.
 - 4. Provide 1 inch minimum spacing between each conduit in cabinet base.
 - a. Cap conduit at both ends until used.

- H. Place cabinet foundation parallel to the roadway. Refer to AT Series Standard Drawings.
- I. Cabinet Foundation Surfaces
 - 1. Ordinary Surface Finish. Refer to Section 03310.
 - 2. Chamfer around top surface perimeter.
 - 3. Level top surface before cabinet installation.
- J. Place preformed expansion joint filler at concrete joints.

3.3 INSTALL PEDESTAL-MOUNTED CABINET

- A. Install pedestal-mounted cabinets so the door that accesses the front face of the control equipment is adjacent to the Type II-PC junction box.
 - 1. Securely fasten the cabinet onto the concrete foundation.
 - 2. Install the cabinet door to be able to fully open and close after the cabinet has been installed on the foundation.
- B. Orient cabinet on foundation with the vented door downstream of traffic.
- C. Caulk between base of cabinet and top of foundation to form a watertight seal. Provide a rain-tight seal that does not degrade the NEMA 3R enclosure rating.
 - 1. Refer to NEMA Standards Publication 250 for ratings of the enclosure for all conduit fittings and chases to adjoining enclosures.
- D. Isolate dissimilar materials from one another by stainless steel fittings.
- E. Make all power connections as shown in the contract and comply with the NEC.
 - 1. Isolate the neutral bus from the cabinet and equipment ground.
 - 2. Terminate the neutral bus at the neutral lug attached to the meter pedestal.

3.4 INSTALL POLE-MOUNTED ATMS CABINET

- A. Install pole-mounted cabinets so the door opens downstream of traffic.
 - 1. Use stainless steel bands. Refer to AT Series Drawings.
- B. Drill and nipple holes in pole at each site.
 - 1. Touch-up damaged galvanized surfaces with zinc based solder both within the hole and around the hole.
- C. Arrange all equipment installed in the cabinet in a neat and orderly fashion on shelf or on DIN rail mount unless otherwise approved by the Engineer.

- D. Connect power as specified in the contract and comply with the NEC.

3.5 INSTALL DISCONNECT, TRANSFORMER, OR BOTH

- A. Install either a supplemental disconnect according to the AT Series Standard Drawings or an approved underground service pedestal according to the SL Series Standard Drawings and Section 16530 unless otherwise specified.
- B. Install disconnect or underground service pedestal between 10-15 ft from the cabinet, away from roadway.
- C. Ground disconnect to ground rod located in Type I junction box at the cabinet base.
- D. Ground the transformer to the control cabinet ground terminal.
 - 1. Comply with NEC requirements.
- E. Install disconnect and transformer according to AT Series Standard Drawings, SL Series Standard Drawings, and the NEC.

3.6 INSTALL CONDUCTORS

- A. Refer to Section 16530.
- B. Bond the grounding conductor from the cabinet ground bus to the ground rod in the Type II junction box.
- C. Terminate all terminal connections by a mechanical (spade) connector.
- D. Identify and label all field terminals and cables.

3.7 INSTALL POWER SOURCE

- A. Refer to Section 16530.

END OF SECTION

SECTION 13556

CLOSED CIRCUIT TELEVISION (CCTV) ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Complete and operational CCTV system.
- B. Installation of State furnished non-lowering and camera lowering CCTV poles, positioner, and dome CCTV assemblies.

1.2 RELATED SECTIONS

- A. Section 02466: Drilled Shaft
- B. Section 03055: Portland Cement Concrete
- C. Section 03211: Reinforcing Steel and Welded Wire
- D. Section 13554: Polymer Concrete Junction Box
- E. Section 13555: ATMS Cabinet
- F. Section 13595: ATMS Integration
- G. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO M 270: Structural Steel for Bridges
- B. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals
- C. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- D. American Iron and Steel Institute (AISI)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 STATE FURNISHED ITEMS

- A. CCTV Pole or luminaire pole
 - 1. Non-lowering CCTV Pole –45 ft steel pole with anchor bolts.
 - 2. Camera Lowering Pole –45 ft, 60 ft, or 75 ft steel pole with anchor bolts.
 - 3 Luminaire Mounted CCTV –Luminaire vertical extension on signal pole.

- B. CCTV Assembly
 - 1. Positioner Camera assembly – includes camera, pan/tilt unit, control receiver, environmental enclosure, and manufacturer's operation manual and equipment list.
 - 2. Dome Camera assembly – includes camera with integrated pan/tilt unit, control receiver, environmental enclosure, and manufacturer's operation manual and equipment list.
 - 3. IPS-RDPE-2 – Remote Data Port Enclosure, 24 Volt Power Supply, IPS cable.
 - 4. Refer to AT Series Standard Drawings to identify the required component parts, installation details, and wiring diagrams.

- C. Camera Lowering System
 - 1. Camera lowering assembly including suspension contact unit, pole adapter for attachment to a pole top tenon, pole top junction box, steel cable, pulleys, support arm, camera connection junction box, and portable camera lowering tool.

- D. Data Surge Suppressor.

- E. Video Surge Suppressor.

- F. Composite CCTV cable

- G. NEMA 3S Pole Mounted Cabinet or NEMA 3S-336S Pole Mounted Cabinet.

2.2 CCTV POLE FOUNDATION

- A. Use drilled shafts according to Section 02466.
 - 1. Use Class AA(AE) concrete – Refer to Section 03055.
 - 2. Use coated reinforcing steel – Refer to Section 03211.

- B. Anchor Bolt Templates – Refer to AASHTO M 270 Grade 36.

- C. Non-Shrink Grout – Refer to ASTM C 1107.

2.3 POLYMER CONCRETE JUNCTION BOX

- A. Refer to Section 13554.

2.4 MOUNTING EQUIPMENT

- A. Provide clamp kit, mounting hardware, pipe, shims, grommet, and all additional equipment to attach CCTV assembly to pole or mast arm.
- B. Provide all stainless steel or hot-dipped galvanized fasteners and hardware.
- C. Provide copper pole grounding lug.
- D. Provide all stainless steel fasteners and attachment hardware for bands and other equipment. Refer to AISI Type 316.
- E. Provide all materials, equipment, and incidentals required to pressurize Dome CCTV cameras in the field.

2.5 CONDUIT

- A. Conduit - Refer to Section 16530.

2.6 CONCRETE MAINTENANCE PAD

- A. Provide 8 ft x 3 ft x 4 inch thick, Concrete Class AA(AE) maintenance pad centered below NEMA 3S - 336S pole mounted cabinet.
- B. Provide 4 ft x 3 ft x 4 inch thick Concrete Class AA(AE) maintenance pad centered below smaller NEMA 3S pole mounted cabinet.

PART 3 EXECUTION

3.1 PREPARATION

- A. Contact the Engineer at least 14 calendar days to schedule pick up of State furnished items.

3.2 INSTALLATION

- A. Load, transport, and install all State furnished items according to the manufacturer's instructions.
- B. Install components as shown. Refer to the AT Series Standard Drawings.
- C. Pressurize Dome CCTV camera in the field according to the Manufacturer's instructions.
- D. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease, and other foreign substances.

3.3 CCTV POLE FOUNDATION

- A. Verify that the installation of the CCTV camera, pole, pole mount cabinet, junction boxes, and foundation in the location marked in the field has no conflict with existing underground and overhead utilities.
- B. Construct foundation according to 02466 and AT Series Standard Drawings.
- C. Cap all conduits before placing concrete.
- D. Place non-shrink grout between base plate and foundation surface after pole is installed.
- E. Bond pole and grounding conductor to concrete encased grounding electrode. Refer to Section 16530.

3.4 ANCHOR BOLTS

- A. Place and hold anchor bolts in proper alignment, position, and height before and during concrete placing and vibrating.
- B. Install anchor bolts according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals Article 5.17.
 - 1. Retighten all nuts after the structure is fully loaded.

3.5 CCTV POLE

- A. Install non-lowering poles with the hand hole facing away from traffic.

- B. Install camera lowering poles with the arm extended toward traffic and the hand hole 90 degrees from the arm allowing access and the view of oncoming traffic.
- C. Install ground lug and connect ground wire from lug to ground rod in the junction box.
- D. Plumb all steel poles to the vertical with all camera equipment installed when adjusting the anchor bolt nuts.
- E. Install steel lowering cable in pole so no contact with any other cable is made during the raising and lowering of the CCTV

3.6 CCTV AND CAMERA LOWERING ASSEMBLY

- A. Assemble the CCTV system including camera and camera housing and prepare for installation according to the manufacturer's instructions before delivery to the job site.
- B. Assemble the Camera Lowering system on CCTV pole and install according to manufacturer's instructions at the job site.
- C. Deliver the CCTV and Camera Lowering systems to the job site, terminate all cabling, and install.

3.7 CCTV COMPOSITE CABLE

- A. Install CCTV composite cables in conduit and poles.
 - 1. Run cables continuously and without splices between camera and cabinet.
 - 2. Do not exceed 500 ft for length of composite cable.
 - 3. Use cable connectors when and where exposed cables enter the pole.
- B. Keep cable ends sealed at all times during installation until connectors are installed using an approved cable end cap.
- C. Install cable without violating the minimum bending radius and the maximum pulling tension recommended by the manufacturer's specifications at any time.
- D. Provide 6 ft of CCTV composite cable slack placed in the junction box adjacent to the cabinet. Refer to Section 13555.

- E. Make all camera cable connections between the CCTV camera, Remote Data Port Enclosure (RDPE), surge suppression device, and communications equipment, as required to provide a fully operational CCTV system.

3.8 POLE-MOUNTED ATMS CABINET

- A. Refer to Section 13555.

3.9 ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

- A. Follow the integration, inspection, testing, and acceptance process according to Section 13595.

END OF SECTION

SECTION 13557

VARIABLE MESSAGE SIGN

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation and testing of all State furnished items including VMS sign assembly, VMS access platform, VMS fiber optic communication cable, and VMS controller.
- B. Furnish and install sign connection hardware, communications cable, surge suppressors, and any additional equipment required. Furnish all incidental items required to provide a complete cable connection between the VMS sign and VMS controller.

1.2 RELATED SECTIONS

- A. Section 02893: Overhead Sign Structure
- B. Section 05120: Structural Steel
- C. Section 13554: Polymer Concrete Junction Box
- D. Section 13555: ATMS Cabinet
- E. Section 13595: ATMS Integration
- F. Section 16530: Electrical Power

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 STATE FURNISHED EQUIPMENT

- A. VMS display
- B. VMS controller
- C. VMS cable (fiber optic)

2.2 POLYMER CONCRETE JUNCTION BOX

- A. Refer to Section 13554.

2.3 ELECTRICAL POWER

- A. Refer to Section 16530.

2.4 SURGE SUPPRESSORS

- A. Use PolyPhaser NX4-60-1G or equivalent products from DITEK or CITEL with the following minimum specifications:
 - 1. Protects Pairs 1-8
 - 2. Protects all Pins (8)
 - 3. Maximum Surge of 100 mA
 - 4. Turn on at 10 mA
 - 5. Typical Capacitance of 55 pF
 - 6. Series Resistance less than 0.02 Ω
 - 7. 0 to 100 percent Humidity
 - 8. Operates in -40 degrees F to 185 degrees F temperatures

2.5 ATMS CABINET

- A. Refer to Section 13555.

PART 3 EXECUTION

3.1 PREPARATION

- A. Contact the Engineer at least 14 calendar days to schedule pick up of State furnished equipment.

3.2 INSTALLATION

- A. Install all wiring, conduit, and junction boxes as shown.
 - 1. Protect existing conductors while installing cables and conductors.
 - 2. Provide and install surge suppressors at the VMS Sign Controller and ATMS Cabinet when connected by conductive communications cable.
- B. Remove shipping supports, connect and arrange all wiring and cables, and verify all parts are properly seated and functional.
- C. Fabricate structural supports and catwalk and mount the VMS to the steel structure. Follow manufacturer's recommendations for bolt torque requirements and tightening. Refer to Sections 02893 and 05120.
- D. Install 1½ inch liquid tight flexible metal conduit, type LFMC and fittings between the sign and sign support inserts. Use high-grade silicon seal to provide a watertight seal around all fittings.
- E. Make final adjustments to sign horizontal and vertical angles.
 - 1. Aim VMS in the direction of on-coming vehicles
 - 2. Type I Overhead VMS
 - a. Mount on full span support structure
 - b. Use for Type I VMS only
 - c. Orient perpendicular to the viewing angle of motorists 800 ft before the sign
 - 3. Type I Cantilever VMS
 - a. Mount on cantilever support structure
 - b. Use for Type I and Type II VMS
 - c. Orient perpendicular to the viewing angle of motorists 800 ft before the sign
 - 4. Roadside Butterfly VMS
 - a. Used for Type II VMS only
 - b. Orient the according to the plans.
 - 5. Adjust the sign angle as determined by the Engineer.
- F. Install power cabling and terminate in VMS cabinet as shown and VMS manufacturer instructions.
- G. Furnish and install all incidental items such as wire connectors, grommets, tape connectors, and electrical terminations necessary to make the VMS system complete.

- H. Install State furnished VMS fiber-optic or Cat 5e controller cable between VMS and VMS controller in ATMS cabinet according to the following requirements:
 - 1. Freeway signs use continuous Multimode fiber
 - 2. Multimode fiber includes a fan out kit and ST connectors
 - 3. Surface street signs use Cat 5e cable
 - 4. Do not exceed 1,000 ft for Cat 5e cable length
 - 5. Coil 6 ft of extra cable in each junction box measured from the top of the junction box going out.
- I. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease, and other foreign substances.

3.3 VMS SUPPORTS

- A. Bond metal supports to concrete encased grounding electrode where it exists. Refer to Section 16530.

3.4 ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

- A. Follow the integration, inspection, testing, and acceptance process according to Section 13595.

END OF SECTION

SECTION 13559

NON-INTRUSIVE DETECTOR (NID) SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and procedures for installing State Furnished Non-Intrusive Detector (NID) System.

1.2 RELATED SECTIONS

- A. Section 13554: Polymer Concrete Junction Box
- B. Section 13555: ATMS Cabinet
- C. Section 13556: Closed Circuit Television (CCTV) Assembly
- D. Section 13595: ATMS Integration
- E. Section 16525: Highway Lighting
- F. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals
- B. American Iron and Steel Institute (AISI)
- C. National Electrical Manufacturers Association (NEMA) Standards
- D. SmartSensorTM Installation Guides (SSIG)
- E. SmartSensorTM User's Guide (SSUG)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Complete Local Field Operations Test form (LFOT) prior to initiating 30 day burn in test in accordance with Section 13595.

PART 2 PRODUCTS

2.1 STATE FURNISHED EQUIPMENT

- A. Non-intrusive detector.
- B. NID Mounting Bracket
- C. NID cable.
- D. NEMA 4X Pole Mounted Cabinet

2.2 LUMINAIRE POLE OR CCTV POLE AND FOUNDATION

- A. Highway luminaire ground mounted pole and light pole foundation. Refer to Section 16525 and SL Series Standard Drawings
- B. CCTV pole and CCTV pole foundation. Refer to Section 13556 and the AT Series Standard Drawings

2.3 POLYMER CONCRETE JUNCTION BOX

- A. Refer to Section 13554

2.4 GROUND ROD

- A. Refer to Section 16530

2.5 MOUNTING EQUIPMENT

- A. Additional mounting hardware as necessary – AISI Type 316 Stainless Steel

PART 3 EXECUTION

3.1 PREPARATION

- A. Contact the Engineer at least 30 calendar days to schedule pick up of State furnished equipment.

3.2 INSTALLATION

- A. Load, transport, and install State furnished materials according to the manufacturer's instructions.

- B. Install products as shown. Refer to AT Series Standard Drawings.

3.3 LUMINAIRE POLE OR CCTV POLE AND FOUNDATION

- A. Construct highway luminaire ground mounted pole and foundation according to Section 16525 and the SL Series Standard Drawings.
- B. Construct CCTV Pole and foundation according to Section 13556 and the AT Series Standard Drawings.
- C. Verify that the installation of the pole, pole mount cabinet, junction boxes, and foundation in the location marked in the field has no conflict with existing underground and overhead utilities.
- D. Place non-shrink grout between base plate and foundation surface after pole is installed.
- E. Install pole with the hand hole facing away from traffic.
- F. Install ground lug and connect ground conductor from lug to ground rod in the junction box according to AT Series Standard Drawings.
- G. Plumb poles to the vertical with NID equipment installed when adjusting the anchor bolt nuts.
- H. Bond pole and grounding conductor to concrete encased grounding electrode. Refer to Section 16530.

3.4 ANCHOR BOLTS

- A. Place and hold anchor bolts in proper alignment, position, and height before and during concrete placing and vibrating.
- B. Install anchor bolts according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals, Article 5.17.
 - 1. Retighten all nuts after the structure is fully loaded.

3.5 NEMA 4X POLE-MOUNTED CABINET

- A. Refer to Section 13555.

3.6 POLYMER CONCRETE JUNCTION BOX

- A. Install junction box near pole if control cabinet is more than 20 ft from pole.

- B. Refer to Section 13554.

3.7 GROUND ROD

- A. Refer to Section 16530.

3.8 NON-INTRUSIVE DETECTOR (NID)

- A. Install items necessary to make the NID system complete and operational.
- B. Install NID to ensure clear line of sight detection.
- C. Mount and connect the NID at locations shown in this Section article 2.2, as shown, and at the height and orientation specified by the NID manufacturer.
- D. Refer to the following for installation:
 - 1. SSIG
 - 2. SSUG
 - 3. AT Series Standard Drawings
 - 4. SL Series Standard Drawings
- E. NID Surge Protectors
 - 1. Install NID surge protector in NEMA 4X enclosure between NID device and ATMS cabinet.
 - a. Mount NEMA Type 4X enclosure on pole, luminaire extension, vertical attachment, arm, or mast arm, 60 inches +/- 6 inches above grade at pole base.
 - 2. Install additional NID surge protector in the ATMS cabinet with the 24 VDC power supply.
- F. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease, and other foreign substances.
- G. Use offset bracketing or other method so that NIDs are mounted out of the lowering path on camera poles with camera lowering devices in use.

3.9 CABLES AND CONDUCTORS

- A. Do not exceed the minimum bending radius or the maximum pulling tension recommended by the manufacturer's specifications at any time.

- B. Keep cable ends sealed at all times during installation using an approved cable end cap.
 - 1. Do not use tape to seal the cable end.
 - 2. Keep cable ends sealed until connectors are installed.
- C. Provide 6 ft of neatly coiled and bundled NID cable slack in junction box adjacent to the cabinet.
- D. Make all NID cable connections between the NID and ATMS cabinet.
- E. Arrange wiring neatly at cabinet, junction boxes, and fixtures.

3.10 ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

- A. Follow the integration, inspection, testing, and acceptance process according to Section 13595.

END OF SECTION

SECTION 13591

TRAFFIC MONITORING DETECTOR LOOP

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Test detector loop and detector cable.

1.2 RELATED SECTIONS

- A. Section 13553: ATMS Conduit
- B. Section 13554: Polymer Concrete Junction Box
- C. Section 13555: ATMS Cabinet
- D. Section 13595: ATMS Integration, Testing, and Acceptance

1.3 REFERENCES

- A. ASTM D 3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
- B. International Municipal Signal Association (IMSA)
- C. National Electrical Code (NEC)
- D. RUS Bulletin 17551-100
- E. Underwriters Laboratories (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit for review all manufacturers' parts list, wiring schematics, installation instructions, shop drawings, and maintenance manuals.
- B. Certified test report of detector homerun cable compliance. Refer to IMSA 50-2.
 - 1. Submit before beginning 30 Day Burn-in Test.

- C. A warranty letter to the Engineer stating that the contractor guarantees the traffic monitoring loop against all material defects for a period of 15 years.
 - 1. The guarantee periods starts on the date of substantial completion.
 - 2. Include in the letter:
 - a. State Project Designation
 - b. State Project Name
 - c. Contractor, Provider, and Installer Name
 - 3. The guarantee covers 100 percent of the traffic monitoring loop materials and installation costs.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Use electrical components as listed and defined by the NEC.

2.2 WIRE

- A. Detector Homerun Cable.
 - 1. 2 Conductor No. 12 shielded polyethylene insulated. Refer to IMSA 50-2.
- B. Detector Loop Wire.
 - 1. PVC Sensor Loop Wire – No. 14, single-conductor, stranded wire. Refer to IMSA 51-3.
- C. Commercially Manufactured Preformed Loop.
 - 1. Abrasion-resistant alloy cover with braided synthetic fiber reinforcement, maximum OD $\frac{3}{8}$ inch.
 - 2. Withstand minimum pressure of 1,400 psi.
 - 3. Flexibility over a wide temperature range and rated to withstand the temperatures of an asphalt overlay project.
 - 4. Resistance to oil, gasoline, salt, moisture, and impact.
 - 5. Loops individually marked showing the direction of the wire turns.
 - 6. Include an additional turn in loops that are more than 8 inches below finished surface to compensate for reduced sensitivity.
- D. Splice Sealing – Refer to Rural Utilities Service (RUS) Bulletin 17551-100.
 - 1. Insulate conductors individually and encapsulate with mastic rubber pads and over wrap with vinyl electric tape.
 - a. Overcoat completed splice with waterproof sealant. Refer to ASTM D 3005, Type I or II.
 - b. Refer to UL 510.

PART 3 EXECUTION

3.1 PREPARATION

- A. The number of preformed loops and the number of lanes varies based on location shown.

3.2 INSTALL PREFORMED DETECTOR LOOPS

- A. Refer to AT Series Standard Drawings.
- B. Preformed Loop
 - 1. Place loops under new pavement 1¾ inches below the surface of the base course and backfill with surrounding material.
- C. Seal loop wire ends immediately upon installation with waterproof coating, coil neatly, and place in a junction box.
- D. Conduit Connection to Junction Box
 - 1. Seal conduit with waterproof bushings. Refer to Section 13553.
 - 2. Fill voids resulting from conduit entrance into junction box with hydraulic cement grout. Refer to Section 13554.

3.3 LOOP WIRE AND LEAD-IN CABLE INSTALLATION

- A. Loop Detection Wire Splicing
 - 1. Splice only in junction box.
 - 2. Splice cables only in detection circuits where the wire type changes in the junction boxes.
 - a. No other splices are allowed.
 - b. Use a nylon tie wrap to secure the loop leads at the best location possible inside the pull box.
 - c. Provide loop leads that are at least 36 inches long as measured from the top of the pull box to allow the Contractor to work on the splice above the box.
 - d. Carry the shield over the splice.
- B. Install detector homerun cable from loop wire to cabinet.
 - 1. Refer to Section 13555.
 - 2. Connect homerun cable to input file in cabinet to make loop detection fully functional at cabinet controller location.
 - 3. Install cabling neat and tight within the ATMS cabinet.

- C. Install detector wiring as shown in Tables 1.

Table 1

Loop Det. #	Position
1	Lane 1 Passage
2	Lane 1 Demand
3	Lane 1 Intermediate Queue
4	Lane 1 Advance Queue
5	Lane 2 Passage
6	Lane 2 Demand
7	Lane 2 Intermediate Queue
8	Lane 2 Advance Queue
9	Lane 3 Passage
10	Lane 3 Demand
11	Lane 3 Intermediate Queue
12	Lane 3 Advance Queue

3.4 ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

- A. Follow the integration, inspection, testing, and acceptance process according to Section 13595 with the following exceptions:
1. Perform LFOT testing after all TMD loop elements, equipment and hardware, power supply, and connecting cabling have been installed.
 - a. It is not necessary for the communications installation to be completed at the time of testing.
 - b. It is not necessary for all stations to be tested concurrently.
- B. Detector Loop Circuit – Conduct the following acceptance tests before and after backfill for approval by the Engineer.
1. Measure and report in ohms, the continuity of each loop.
 2. Value to be within 5 percent of calculated values.
 3. Loop Resistance Formula $R_t = R_l + R_d$.

Where:

- R_t = Resistance of loop as measured at pull box.
 R_l = Resistance of loop lead in wire (from the loop to junction box). Equal to 0.002525 ohms per foot (times 2) measured from loop to pull box splice point.
 R_d = Resistance of Loop = $P \cdot T \cdot R_c$ (See Loop Resistance Table below).
 P = Perimeter of loop in feet.
 T = Number of turns in the loop.
 R_c = Resistance of #14 AWG copper wire per foot equals 0.002525 ohms.

Table 2

Loop Resistance			
Loop Type			R _d Loop Resistance (ohms)
Width (ft)	Length (ft)	Turns	
5	6	4	0.22
5	10	4	0.32
6	Circular	4	0.19
6	Circular	5	0.24
6	6	4	0.24
6	10	4	0.32
6	12	4	0.36
6	14	3	0.30
6	16	3	0.33

4. Measure and report each loop's insulation resistance.
 - a. Minimum acceptable reading measured between the loop conductor and ground is 50 MΩ or greater when tested with a 500 V megohm meter.
5. Measure and report the inductance of each loop.
 - a. Acceptable inductance readings are greater than 90 μH for individual loops and less than 1,000 μH for a 4 loop group.

END OF SECTION

SECTION 13592

ROADWAY WEATHER INFORMATION SYSTEM – ENVIRONMENTAL SENSOR STATION (RWIS-ESS)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. RWIS site preparation, including installing conduit, junction boxes with grounding rods, tower foundation and tower lower section, and concrete pads.
- B. State furnished and State installed equipment.

1.2 RELATED SECTIONS

- A. Section 02056: Embankment, Borrow, and Backfill
- B. Section 02466: Drilled Shafts
- C. Section 02721: Untreated Base Course (UTBC)
- D. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork
- E. Section 03055: Portland Cement Concrete
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 03310: Structural Concrete
- H. Section 13553: ATMS Conduit
- I. Section 13554: Polymer Concrete Junction Box
- J. Section 16530: Electrical Power

1.3 REFERENCES

- A. American National Standards Institute (ANSI)
- B. National Electrical Code (NEC)
- C. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STATE FURNISHED ITEMS

- A. Tower Base, Lower Tower Section.
- B. RWIS Cabinet.
- C. Solar Enclosure.

2.2 POWER

- A. Use electrical components as listed and defined by the National Electrical Code (NEC).
- B. Conduit - Refer to Section 13553.
- C. Junction Boxes – Refer to Section 13554.

2.3 CONCRETE SERVICE PAD

- A. Untreated Base Course. Refer to Section 02721.
- B. Concrete Flatwork. Refer to 02776.
- C. 6x6-W1.4-W1.4 steel welded wire reinforcement. Refer to Section 03211.

2.4 CONCRETE FOUNDATION

- A. Use drilled shafts according to Section 02466.
 - 1. Use Class AA(AE) concrete – Refer to Section 03055.
 - 2. Use coated deformed reinforcing steel – Refer to 03211.

2.5 TOWER AND SOLAR GROUNDING SYSTEM

- A. Wire – #4 solid bare copper grounding conductor. Refer to AT Series Standard Drawings and NEC Article 250.
- B. Ground Rod – Refer to Section 16530 and NEC Article 250.

- C. Ground Clamps
 - 1. Rod clamps ANSI rated and UL listed for use on $\frac{3}{4}$ inch copper bonded steel rods and #4 solid bare copper grounding conductor.
 - 2. Pipe clamps ANSI rated and UL listed for use on 1 inch aluminum pipe.
 - 3. Pipe clamps ANSI rated and UL listed for use on 4 inch steel pipe.

PART 3 EXECUTION

3.1 PREPARATION

- A. Notify the Engineer a minimum of 30 days in advance of beginning work on RWIS-ESS facilities.
- B. Contact the Engineer at least 14 calendar days to schedule pick up of State furnished items.
- C. Pick up State furnished items at the following location:

Utah Department of Transportation
Traffic Operations Center (TOC)
2060 South 2760 West
Salt Lake City, Utah 84104
- D. Obtain approval for tower site location and pavement sensor placement (if required) before construction.

3.2 INSTALLATION

- A. Load, transport, and install all State furnished items according to the manufacturer's instructions.
- B. Refer to the National Electrical Code (NEC).
- C. Construct according to the AT Series Standard Drawings

3.3 RWIS TOWER FOUNDATION AND SERVICE PAD

- A. Provide all necessary grading for a flat and level site. Refer to Section 02056.
- B. Finish all surface concrete with Ordinary Surface Finish. Refer to Section 03310.

3.4 TOWER GROUNDING SYSTEM

- A. Wire— Install one #4 solid bare grounding conductor for each tower leg.
 - 1. Clamp wire to the outside ground rod 10 ft from tower leg and run to the inside ground rod (3 ft from tower leg).
 - 2. Clamp wire to the inside ground rod.
 - a. Do not cut the wire.
 - 3. Run the wire below then penetrate up through the concrete pad to the corner of the RWIS tower.
- B. Install concrete encased grounding electrode in foundation and bond to tower base and equipment grounding conductor. Refer to Section 16530.
- C. Ground Rod
 - 1. Install ground clamps on $\frac{3}{4}$ inch copper bonded steel rods and attach #4 solid bare copper wire, buried in earth or concrete.
 - 2. Install ground pipe clamps on each leg of lower tower section and connect grounding conductors.

3.5 SOLAR GROUNDING SYSTEM

- A. Wire— Install one #4 solid bare grounding conductor to solar pole.
 - 1. Clamp wire to the outside ground rod 10 ft from pole and run to the inside ground rod (3 ft from pole).
 - 2. Clamp wire to the inside ground rod.
 - a. Do not cut the wire.
 - 3. Run the wire below then penetrate up through the concrete pad and attach to the solar pole.
- B. Install concrete encased grounding electrode in foundation and bond to solar pole and equipment grounding conductor. Refer to Section 16530.
- C. Ground Rod
 - 1. Install ground clamps on $\frac{3}{4}$ inch copper bonded steel rods and #4 solid bare copper wire, buried in earth or concrete.
 - 2. Install ground pipe clamps on solar pole.

3.6 DEPARTMENT INSTALLED ITEMS

- A. The Department will supply and install
 - 1. Upper tower section and associated equipment.
 - 2. Solar panels, mounting bracket, and battery box.
 - 3. Communication equipment.
 - 4. RPU
 - 5. Environmental Sensors

END OF SECTION

SECTION 13594

FIBER OPTIC COMMUNICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation and testing of fiber optic communication systems.

1.2 RELATED SECTIONS

- A. Section 13553: ATMS Conduit
- B. Section 13595: ATMS Integration

1.3 REFERENCES

- A. Telecommunications Industry Association (TIA) and Electronic Industries Association (EIA) Specifications
- B. National Electrical Code (NEC)
- C. Telcordia Guidance
- D. Underwriters Laboratory (UL)
- E. USDA Rural Utilities Service (RUS)

1.4 DEFINITIONS

- A. Backbone – Cable that connects two buildings or a building to a Hub/Node
- B. Drop – Cable that originates at a distribution splice, interface cabinet, or device and terminates at or links served devices.
- C. Fiber Distribution Unit (FDU) – A storage and management box for use in cabinets and communication hubs for the terminated ends and splice points of the fiber optic cable.
- D. Full Splice – A splice that has had all fibers spliced.
- E. Ring Cut Splice – A splice where only selected fibers are severed and others remain intact.

1.5 SUBMITTALS

- A. Fiber Optic Technician Resume and Fiber Optic Training Certificate for all fiber optic staff including installation, splice, and test technicians; before any fiber optic work begins. Refer to this Section, Article 1.7.
 - 1. Resume showing a minimum of 2 years of fiber optic work experience.
 - 2. Nationally recognized Fiber Optic Training Certificate of Completion for the fiber optic training course.
- B. Pre-Construction Submittal
 - 1. Factory test results showing the attenuation of each cable fiber in dB/km measured at 1310 nm and 1550 nm.
 - 2. Pre-Construction Fiber Optic Cable Reel Test.
 - 3. Fiber optic cable specifications listed in this Section, Article 2.3D
 - 4. Submit prior to installing any fiber optic cable
- C. Post Installation Submittal
 - 1. Optical Time Domain Reflectometer (OTDR) Test Results
 - a. Include both electronic PDF and OTDR generated versions of each test result.
 - b. Current OTDR calibration certificate.
 - c. Electronic submittal on two CDs or USB Flash Drives.
 - d. Performed prior to the 30 day burn-in test. Refer to Section 13595
 - 2. Power Meter/Light Source Test Results
 - a. Obtain the current test form from the Engineer.
 - b. Include electronic PDF version of completed test form with electronic submittal.
 - c. Performed prior to the 30 day burn-in test. Refer to Section 13595.

1.6 SPLICE PLANS

- A. Request Project Splice Plans from the Engineer.
 - 1. Include Splice Plans, testing forms and device assignments to fiber channels in Splice Plans.
 - a. Request splice plan 30 days before the desired start date of splicing and after junction boxes have been placed.
- B. A field mapping review is required and will be performed by the Department to initiate Splice Plan production.
 - 1. Provide onsite coordination during the field mapping review.

2. The 30-day Splice Plan delivery period may be delayed in the event that all junction boxes are not present during the field mapping review.

1.7 INSTALLERS QUALIFICATIONS

- A. Complete a three-day course on fiber optic cable installation, splicing, and testing.
 1. Course conducted by a fiber optic supplier or established education provider.
 2. In-house and on the job training are not acceptable.
- B. Demonstrate two years total and one year continuous work experience with the fiber optic cable splicing, termination, and testing.
- C. Perform all work with qualified staff.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide materials that are UL listed.
- B. Provide all incidental materials including fiber optic jumpers, cable ties, labels, tie wraps, connectors and consumables.
- C. Outside plant materials meet Fluid Penetration Test standards (TIA/EIA-455-82B).
- D. Provide and install all cable in continuous lengths.
- E. Provide all optical glass from the same manufacturer.

2.2 FIBER OPTIC CABLE

- A. Approved for use by the Rural Utilities Service (RUS).
- B. Outside Plant (OSP) type, loose tube, single-mode fiber optic cable.
 1. Cable call outs for armored or all-dielectric cable: As specified and as shown.
 2. Microfiber cables are not required to be armored.
- C. Use gel filled fiber optic cable complying with Telcordia GR20-CORE and TIA/EIA-4720000-A.

- D. Use cable with individual buffer tubes and individual fiber strands color coded in compliance with EIA/TIA-598 Color Coding of Fiber Optic Cables.
1. Individual buffer tubes may contain 6 or 12 fiber strands only.

Table 1

Fiber Optic Glass Optical Fiber Specifications	
PARAMETERS	SINGLE MODE
Type	Step Index
Core Diameter	8.2 μm (Nominal)
Cladding Diameter	125 $\mu\text{m} \pm .7 \mu\text{m}$
Core to Cladding Offset	$\leq 0.8 \mu\text{m}$
Coating Diameter (OSP)	245 $\mu\text{m} \pm 5 \mu\text{m}$
Coating Diameter (IP)	900 $\mu\text{m} \pm 15 \mu\text{m}$
Cladding Non-circularity	$\leq .7\%$
Proof Tensile Test	100 kpsi (0.7 GN/m ²)
Attenuation (Maximum Allowed)	
@ 850nm(MM)	N/A
@ 1300nm(MM)	N/A
@ 1310nm(SM)	0.40 dB/km
@ 1550nm(SM)	0.30 dB/km
Bandwidth	
@ 850nm(MM)	N/A
@ 1300nm(MM)	N/A
Chromatic Dispersion	
Zero Dispersion	1301.5/1321.5 nm
Wavelength Zero	
Dispersion Slope	$\leq 0.092 \text{ ps}/(\text{nm}^2 \cdot \text{km})$
Maximum Dispersion	3.3 ps/(nm·km) for 1285-1330nm < 18 ps/(nm·km) for 1550nm
Cut-Off Wavelength	1260 nm
Numerical Aperture	
(EIA-455-47)	N/A

- E. Outer Jacket Labeling
1. Date of manufacture and the manufacturer's name.
 2. A numerical sequence at intervals no greater than 10 ft.
 3. "Utah Department of Transportation" or "UDOT" or "DOT" at an interval of no greater than 10 ft.
 4. Marking height $\frac{1}{8}$ inch nominal.

- F. Label and tag all fiber optic cables in every accessible location, 6 inches from the end plate on enclosures using Electromark, ACP International or Panduit PST-FO (2 inch x 3.5 inch) with the following information:
1. Strand count
 2. Location
 3. Type of circuit such as drop cable, distribution, and backbone
 4. Example:
Direction of Fiber (North, South, East, or West)
48 ct Single Mode Fiber Optic (SMFO)
Locate ID = 3500 So Distribution
or
Locate ID = Drop CCTV @ Main St and Center St
- G. Solvent requirements
1. Must not remove any color from individual fibers. Refer to TIA/EIA-598-A or buffer tubes.
 2. Not harmful to the polyethylene cable jacket.

2.3 FIBER OPTIC DROP CABLE

- A. Drop Cable
1. Six single mode fibers
 2. All dielectric, non-armored cable
 3. Single buffer tube
 4. Gel filled
 5. Central core construction
 6. Rated at a minimum of 400 lb pulling tension
 7. Meets RUS requirements
 8. Supply with ST connectors only
 9. Locatable mule tape with each drop cable
- B. Use a Pre-Terminated Drop Cable Unit
1. Factory assembled.
 2. Pre-terminated with a 6 fiber port molded patch panel unit that acts as a cabinet FDU.
 3. Submit drop cable product specifications to Engineer for approval before their use.
 4. Locatable mule tape with each pre-terminated drop cable unit.
- C. Submit factory test results for each drop cable assembly
1. Test results include reflectance and insertion loss.
 2. Test report references the serial number of the assembly.
 3. Submit the test report to the Engineer before installation.
 4. Include electronic PDF version of test report with the electronic submittal.

- D. Ship the pre-terminated assembly coiled or on a spool with the free end of the cable on the top end of the coil or spool.

2.4 FIBER OPTIC CONNECTORS

- A. Supply connector type on jumpers as described.
 - 1. ST – Connectors (Standard)
 - a. Factory installed or field installed single mode ST or single mode ST compatible connectors
 - b. Ceramic ferrules
 - c. Maximum insertion loss 0.30 dB
 - d. Connector back reflection greater than 40 dB

2.5 FIBER OPTIC JUMPER/PATCH CORDS

- A. Supply jumper and patch cords that are:
 - 1. Factory made
 - 2. Buffered
 - 3. Strengthened with aramid yarn
 - 4. Utilize ST connectors
 - 5. No more than 3 ft long in field cabinets and no more than ten ft long in communication hubs
 - 6. Contain no splices or mid-length couplers
- B. Inside plant (IP) Jumpers
 - 1. Meet NEC jacketing requirements
 - 2. Outer jacket color
 - a. Orange for multimode jumpers
 - b. Yellow for single mode jumpers
- C. Jumper Connectors
 - 1. Connectors will mate directly to the optical interfaces on the equipment and to the optical coupler ports on the jumpers.
 - 2. No additional couplers are allowed.
 - 3. Use only one type of connector on any assembly or subassembly.
- D. Clean all connectors utilizing an alcohol-free wipe.

2.6 HUB FIBER OPTIC DISTRIBUTION UNIT (FDU)

- A. Supply FDU with:
 - 1. Splice storage area with splice trays
 - 2. One per buffer tube, as required
 - 3. Patch panel up to 144 terminations as shown.
 - 4. Fiber optic ST couplers installed within the patch panel
 - 5. Cover to protect the terminations and splices stored within the FDU

2.7 FIBER OPTIC CABLE SPLICE ENCLOSURE

- A. Provide splice enclosures with the following minimum characteristics:
 - 1. Complies with Telcordia GR-771
 - 2. Corrosion resistant shell
 - 3. Allows re-entry without replacing the cable seals
 - 4. Strength member tie-off
 - 5. External ground lug
 - 6. Enclosure must be bonded inside and outside
 - 7. Mechanism to resist cable pull-out
 - 8. All required accessories to complete the splice
 - 9. Six cable ports and applicable hardware
 - 10. Dome style enclosure
 - 11. Accommodates up to 288 splices
 - 12. Contains two or more 36-count splice trays

PART 3 EXECUTION

3.1 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

- A. Do not cut fiber cable or perform fiber splices in locations that are not shown in Department furnished Splice Plans.
- B. Notify the Engineer a minimum of five business days in advance of installing fiber optic cable into any existing conduit, ATMS site, or building facility or before beginning any testing required to be witnessed by Department.
- C. Perform all work in facilities on conduits, junction boxes, cabinets, and buildings containing the Department's existing equipment only in the presence of the Engineer or his authorized representative.
- D. Restore contractor-caused damage or breaks to in-use project fiber cable and its conduit within 24 hours of damage.
- E. Lubricate cable with a lubricant designed for fiber optic cable installation. Use the following minimum lubricant quantity for each cable pull:
$$Q = 0.0008 * D * L$$

Where: Q = the quantity of lubricant (gallons)
 D = the diameter of the conduit (inches)
 L = the length of the pull (feet)
- F. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension as rated by the cable manufacturer.

- G. Maintain the following minimum bend radii:
 - 1. 20 times Cable Diameter during installation.
 - 2. 10 times Cable Diameter installed.

- H. Cable Slack Requirements
 - 1. Pull and store excess cable slack at designated intervals, including at each pull box, splice box, hub, and each TMC or TOC.
 - 2. Equally distribute the slack on either side of the splice enclosure.
 - 3. The following are minimum required lengths of slack cable – slack at locations with splice enclosures is measured from enclosure end plate to conduit.
 - a. Type II and III Poly Concrete Junction Box (No Splice)-100 ft
 - b. Fiber Splice Point Junction Box or Vault (Cable End)- 50 ft
(Ring Cut Location) - 100 ft
 - c. Future Splice Point (total slack)- 100 ft
 - d. Bridge Barrier Wall (Each End of Bridge)- 15 ft
 - e. Device Cabinet- 15 ft
 - f. Hub Building (Outside)- 75 ft
 - g. TMC and TOC (OSP Entrance)- 50 ft Max
 - h. TMC and TOC (IP at Equipment Room) - 50 ft Max
 - i. Drop Cable- 65 ft
or equal in length to existing fiber cable plus 10 ft for splicing
 - 4. Provide proper storage of slack cable, both long term and short term.
 - a. Do not leave slack cable lying free on the ground or floor of a Device Cabinet/Hub/TOC/TCC except during the pulling process.
 - b. Neatly bind cables to be spliced together from conduit to splice enclosure with tape.
 - c. Submit shop drawings of the materials and installation of the anchored mounting channels to be installed in these areas for approval by the Engineer.

- I. Damage to the fiber optic cable, defect, or nonconformances of this Section must be resolved by removing and replacing entire segments of fiber optic cable between full splice points.

- J. Install microfiber cable into standard conduit sizes by jetting or blowing method or, by pulling method while adhering to the maximum cable pulling tension as rated by the cable manufacturer.

- K. Install fiber optic cables into conduits or microducts:
 - 1. Conduit color-code according to Section 13553
 - a. Install cables in the following order: blue, orange, green, brown, slate, white, red and black.
 - 2. Microduct color-code according to Section 13553
 - a. Install cables in the following order.
 - 1) Oversheath: blue, orange, green and brown.
 - 2) Microduct: blue, orange, green, brown, slate, white, red and black.
- L. Install fiber optic cables continuously within one conduit or microduct color throughout the entire cable run.
- M. Terminate fibers as described in the Splice Plans.
- N. Install new cabinet FDUs to replace any fan-out kits or FDUs that must be severed to make fiber terminations
- O. Ground and bond the armor when installing armored fiber optic cable.
 - 1. Meet NEC Article 250 and 770 requirements for grounding and bonding armored cable.

3.2 ENTRY AND REENTRY OF FIBER OPTIC SPLICE ENCLOSURES

- A. Perform all work in an environmentally controlled atmosphere.
 - 1. Acceptable environments include office type environments in buildings, splice trailers, and splicing tents with floors.
 - 2. Do not splice, test, connect, or open fiber ends in locations with freezing temperatures, rain, snow, or wind-blown dust.
 - 3. Verify connectivity of all working fiber.
 - 4. Verify connectivity and test according to this Section, Article 3.6 paragraph B before closing.

3.3 FUSION SPLICING

- A. Use fusion splice method for all fiber splicing.
- B. Perform fusion splices as follows:
 - 1. Use equipment with automatic fiber alignment and automatic light injection with detection devices or profile alignment algorithms to estimate splice losses.
 - 2. Provide splice enclosure as a protection for all splices and stripped cable.
 - 3. House all splices in splice trays.

4. Use heat shrink tubing containing internal strength member to provide additional protection and strain relief of each fusion splice inside of splice tray.
5. Comply with maximum splice loss allowance of 0.05 dB as measured with a fusion machine as described in this Section, Article 3.6 paragraph B.

3.4 SPLICE ENCLOSURE AND TRAY LABELING REQUIREMENTS

- A. Provide a minimum of 3 ft of buffer tube slack from end plate.
- B. Provide label for each buffer tube located 1 inch from the splice tray.
 1. Description on label will identify which fiber cable and direction cable is coming from.
 2. Label will also include device type such as CCTV, VMS, or TMS.
 3. Label distribution buffer tubes with tags marked "Distribution" and include direction of path such as westbound or eastbound.
- C. Provide 3 to 4 ft of fiber optic strands outside of buffer tube from each cable before splicing.
- D. Store all excess splice enclosure parts and hardware within the manufacturer supplied plastic bag and place inside of the enclosure for future use.
 1. Verify parts and hardware are securely fastened inside of the enclosure to prevent damage of fiber optic buffer tubes and strands.
 - a. Loose parts and hardware inside of the enclosure are strictly prohibited.

3.5 ACCEPTANCE TESTING

- A. Pre-Installation Test (reel test)
 1. Test the fiber optic cable at the site storage area before installation.
 2. Test two optical fibers from each buffer tube from one end with an OTDR compatible with wavelength and fiber type.
 3. Test for continuity, length, anomalies, and approximate attenuation.
 4. Record each measurement with color, location, and type of fiber measured.
 5. Test for contractor protection only. Submit to the Engineer upon request.
 6. Use no less than 1,000 ft of launch cable.

- B. Post Installation Tests
1. Contact the Engineer a minimum of five business days before performing tests (Post Termination and Splicing OTDR and Power Meter).
 2. Perform all fiber optic testing with an OTDR capable of producing output files that are compatible with Department OTDR software or furnish the software necessary for viewing the OTDR data.
 3. OTDR Testing Requirements
 - a. Test every fiber strand passing through any open splice tray after completing the required work.
 - 1) Test all fibers both within the trunk cable and the drop cable.
 - b. Conduct all traces with a launch cable or fiber test box between the OTDR and the fiber under test.
 - c. Do not exceed insertion loss 1.0 dB.
 - d. Conduct all traces at both 1310 nm and 1550 nm.
 - e. Provide traces with the following information:
 - 1) Horizontal Axis – Distance in feet.
 - 2) Vertical Axis – Attenuation scale in dB.
 - 3) Traces showing attenuation versus distance.
 - 4) Cursors positioned at cable ends.
 - f. Tabulate for each trace – method, fiber type, wavelength, pulse width, refractive index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, and operator initials.
 - g. Provide an event table showing all events with more than 0.05 dB loss containing event type, position from OTDR end, loss, and reflectance.
 - h. The maximum total allowable attenuation is 1.0 dB for cables less than 3,300 ft (1 km) in length.
 - i. Identify fibers by strand number.
 - j. Submit electronic PDF version of fiber optic testing report on two CDs or USB Flash Drives, and organize by cable and strand number.
 - k. A cover sheet is required for each electronic PDF fiber optic testing report indicating which cables were tested, OTDR user's name, reviewer's name, test type performed, and the test date.
 - l. Cover sheets are required for final test results with reviewer's signature, date, and a statement indicating the installation complies with the requirements of this section.

- m. The Contractor's employee who has reviewed the traces is required to sign or initial them. A check mark is required on all traces that satisfy the requirements identified herein. Flag any discrepancies that may exist with a short description of the proposed corrective action such as re-splice for intermediate test results.
- n. Submit electronically on two CDs or USB Flash Drives with printed indexes.
- o. Cable tested by certified staff.
- p. Perform testing in presence of the Engineer and authorized UDOT Fiber Group designee.
- 4. Post Termination Test Acceptance Criteria
 - a. Cable attenuation 0.4 dB/km at 1310 nm excluding splices as shown or authorized by the Engineer.
 - b. Cable attenuation 0.3 dB/km at 1550 nm excluding splices as shown or authorized by the Engineer.
 - c. Strand lengths are consistent.
 - d. Insertion loss < 1.0 dB.
 - e. No event > 0.30 dB.
 - f. Trace produced for each strand in all cable segments including drop cable.
- 5. Power Meter/Light Test
 - a. Connect the light source to the connectorized fiber at the location identified on the Fiber Optic Light Source Power Meter Test Form provided by the Engineer.
 - 1) Connect a power meter to the other end of the fiber at the location identified on the test form.
 - 2) Record the results and include an electronic PDF version of completed test form with the electronic submittal.
 - b. Use the light frequencies of 1310 nm and 1550 nm or as indicated in test forms.
 - c. Test every field location required to obtain access to each cable segment.
 - d. Perform all testing using two qualified fiber optic technicians and two vehicles.
 - e. A Department inspector and the Fiber Department Representative must witness and verify results in order to obtain approval of the Engineer.
 - f. Obtain approval of results.

END OF SECTION

SECTION 13595

ATMS INTEGRATION, INSPECTION, TESTING, AND ACCEPTANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Integrate all project ATMS devices including successful completion and documentation of all required inspections and operational tests.
- B. Installing, connecting, and configuring all incidental equipment and components as required for a complete and operational system.
- C. Provide all necessary test equipment and other products necessary to test the integrated ATMS device, sub-systems, and systems with no additional cost to the Department.

1.2 RELATED SECTIONS

- A. Section 13431: Precast Concrete Fiber Optic and Utility Vault
- B. Section 13553: ATMS Conduit
- C. Section 13554: Polymer Concrete Junction Box
- D. Section 13594: Fiber Optic Communication
- E. Section 16530: Electrical Power

1.3 REFERENCES Not Used

1.4 DEFINITIONS

- A. Integration – The process of enabling the completed ATMS device to function as intended. This includes but may not be limited to connecting all items such as required communication, control, and power cables, entering all required device parameters, aiming devices such as antennas, calibrating or adjusting devices, enabling communication to the device from the TOC, and completing all specified tests to verify that integration is complete.

1.5 SUBMITTALS

- A. Testing Forms – Refer to this Section, Article 3.2.
 - 1. Conductor Test Form
 - 2. ESI punch list.
 - 3. LFOT Form
 - 4. 30 Day ATMS burn-in test form.
 - a. Equipment Failure Report, if applicable.
- B. ATMS Testing Pre-Notification Forms 5 days before performing:
 - 1. ATMS Cable and Conductor Test
 - 2. ESI
 - 3. LFOT
 - 4. SCI
 - 5. 30 Day ATMS burn-in test.
- C. Refer to <http://www.udot.utah.gov/go/standardsreferences> for blank forms for this Section.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 INTEGRATION

- A. Provide qualified staff or sub consultants to perform ATMS device integration.
 - 1. Use only those firms pre-certified by the Department to perform ATMS integration.
- B. Do not apply AC power to any device, cabinet, or system until after the Engineer's Site Inspection and without the oversight of qualified integration personnel.

3.2 INSPECTION AND TESTING

- A. Testing and acceptance process
 - 1. Follow the required steps in the ATMS device testing and acceptance process shown in Table 1.
 - 2. Conduct testing and inspection steps in sequence.
 - a. Multiple steps may be conducted on the same day with adequate notification and scheduling.

3. Completion of all required submittal, integration, and testing steps as well as receipt of notification from the Engineer is required for acceptance.
4. Perform testing, except for 30 Day ATMS burn-in test, in the presence of the Department and document with Department signature.

Table 1

ATMS TESTING AND ACCEPTANCE PROCESS MATRIX		
REQUIRED TEST	PREREQUISITES	DESCRIPTION
Punch List from Engineer's Site Inspection (ESI)	Complete and submit at the time of the Engineer's Site Inspection (ESI).	Include on the ESI Punch List items that must be completed or adjusted before any part of a device or system installation is energized.
5 Day ATMS Testing Pre-Notification	Submit 5 days in advance of proposed test dates	Test form to the Engineer 5 days before each test or inspection that must be witnessed by the Department or authorized representative.
ATMS Cable and Conductor Test	Basic construction of conduits, boxes, wiring, and cabinets. Perform this test after wire has been pulled but before devices are energized	The ATMS Cable and Conductor Test is used to confirm that cable is not faulty and has not been damaged during installation
Engineer's Site Inspection (ESI)	Receipt of all required submittals as noted in Sections 13431, 13553, 13554, 13594, 16530, and completion of basic construction elements	The ESI is used to confirm that the device or system has been constructed according to the project requirements and is ready to be energized and begin the integration process. The ESI will note any obvious issues with wiring, configuration, incorrect inventory, differences from Project Plans, or general cleanliness of the site.
Local Field Operations Test (LFOT)	Successful completion of local configuration and integration as well as completion of operational punch list items from the ESI	The LFOT is used to confirm that the device or system has been configured and integrated according to the project requirements and is ready to be tested centrally.
Systems Test (if required)	Successful completion of LFOT and integration of device to central TOC control	Project specific by Special Provision. Certain projects or types of devices may require a complete system test where multiple elements, applications, or devices are tested simultaneously

ATMS TESTING AND ACCEPTANCE PROCESS MATRIX		
REQUIRED TEST	PREREQUISITES	DESCRIPTION
Substantial Completion Inspection (SCI)	Successful completion of the LFOT, successful integration of device to the Traffic Operations Center, active central communications to device	The SCI is used to confirm that the ATMS device, subsystem, or system meets the operational parameters described within the project plans, specifications, and Special Provisions. The Contractor must demonstrate the remote device sites communicate to the TOC and operate as a single integrated system as required in the project requirements in addition to having all construction and integration tasks completed. The system will be considered substantially complete and may begin the 30 day ATMS burn-in period with the successful completion of this inspection and testing.
30 Day ATMS Burn-In Period	Successful Substantial Completion Inspection and submission of the 30 day ATMS burn-in test form.	The 30 day ATMS burn-in period confirms that the ATMS device or system was properly constructed and integrated.
Acceptance	Satisfactory completion of the 30 day burn-in test, completion of all items on the Engineer's Site Inspection punch list, and submittal of approved As-Built drawings.	Acceptance transfers ownership of the system or devices to the Department. At that point the warranty begins and the ownership and maintenance of the site or system transfers to the Department. Written notification from the Department to the contractor is required for Final Acceptance to occur.
Construction As-Built Drawings	Within 5 days after the 30 Day ATMS Burn In Test. As-Built drawings will be reviewed, verified, and accepted before final device or system acceptance.	As-Built drawings of each ATMS device installation showing actual locations of all installed conduit, boxes, and cabinets, and any differences in construction from plans.
Fiber Optic Test Results	Fiber optic cable test results.	Refer to Section 13594 – Fiber Optic Communication for specific testing and submittal requirements.

B. ATMS Cable and Conductor Test

1. Perform the Cable and Conductor Test before making any connections.
2. Complete and submit Conductor Test Form.
3. Verify that all cables and conductors are installed according to the project requirements and the manufacturer's recommended best practices before testing.
4. Perform all resistance testing after final termination and cable installation but before any electronics or field device connections.

5. Replace cable and retest if any cable fails to meet the parameters of the test or if any testing reveals any defects in the cable.
 6. Furnish all equipment, appliances, and labor necessary to test the installed cable and conductors.
- C. Engineer's Site Inspection (ESI)
1. Prepare for and complete the ESI after the completion of civil construction of device.
 2. Generate, maintain, submit, and track a punch list of items that must be complete before:
 - a. The device may be energized
 - b. The device may be accepted
 3. Complete the ESI and critical punch list items before energizing the cabinet or any internal device.
- D. Local Field Operations Test (LFOT)
1. Conduct the LFOT after completing the ESI punch list items and receiving.
 2. Complete and submit LFOT form.
 3. Verify that all devices and material are installed according to the project requirements and manufacturers recommended best practices before testing.
 4. Repair, replace, adjust, or otherwise address issues with the device that prevents all test steps from passing.
 - a. Repeat test steps during and after repair until step is passed.
- E. Substantial Completion Inspection (SCI)
1. Prepare for and complete the SCI after completing the LFOT and receiving.
 2. Notify Region Blue Stakes Coordinator of the SCI walk-through.
 3. Verify that central communications to the device is active before initiating the SCI.
 4. Generate, maintain, and track SCI punch list of items.
- F. 30 Day ATMS Burn-In Test
1. Conduct the 30 Day ATMS burn-in test after completing the SCI.
 2. Complete and submit the 30 Day ATMS burn-in test form.
 3. Verify that central communications and electrical power are continually available during the 30 day test period.
 4. The Engineer or designated representative will coordinate and oversee the full life-cycle of the burn-in period.
 - a. Operators at the TOC will monitor and exercise the devices remotely during the burn-in test.
 - b. The burn-in period will continue for 30 days, unless an equipment failure occurs.

5. Perform a diagnostic test in the event that an equipment failure occurs.
 - a. Respond and conduct diagnostic test within 24 hours of notification by the Engineer.
 - b. The burn-in test will be suspended during diagnostic testing.
6. Complete all necessary work to correct the problem within 24 hours of notification unless the Engineer allows additional time.
7. Submit Equipment Failure Report to the Engineer within 72 hours after notification of the problem.
 - a. Fully describe the problem, its cause, and all actions taken to rectify the failure.
 - b. Provide the manufacturer's name, model, field location, and serial number for all equipment, materials, or software listed in the report.
 - c. Meet the operational requirements and project specifications for all equipment or modules used in the replacement or repair subject to the full testing process.
8. Do not perform field repairs on electrical or electronic equipment.
 - a. Replace malfunctioning electrical or electronic equipment with like-kind.
9. Within two working days after receiving the Equipment Failure Report the Engineer will notify Contractor whether the 30 day burn-in test will be continued, extended until a set time is reached, or restarted by setting time back to day zero.

3.3 ACCEPTANCE

- A. The device, system, or sub-system may be accepted upon completion of the successful 30 Day ATMS burn-in test. To complete the acceptance process:
 - a. Confirm As-Built drawings have been submitted, verified, and approved.
 - b. Confirm required submittals have been submitted.
 - c. Complete all ESI and SCI punch list items.
 - d. Request device acceptance.

END OF SECTION

SECTION 16525

HIGHWAY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Lighting for highway, understructure, sign, bridge, parking lot, and other lighting systems.

1.2 RELATED SECTIONS

- A. Section 02466: Drilled Shafts
- B. Section 02741: Hot Mix Asphalt (HMA)
- C. Section 02842: Delineators
- D. Section 03055: Portland Cement Concrete
- E. Section 03211: Reinforcing Steel and Welded Wire
- F. Section 03575: Flowable Fill
- G. Section 05120: Structural Steel
- H. Section 09972: Painting for Structural Steel
- I. Section 13554: Polymer Concrete Junction Box
- J. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO M 111: Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
- B. AASHTO M 232: Zinc Coating (Hot Dip) on Iron and Steel Hardware
- C. AASHTO Standard Specification Structural Supports for Highway Signs, Luminaires, and Traffic Signals (current edition)
- D. ASTM A 36: Carbon Structural Steel

- E. ASTM A 572: High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- F. ASTM B 29: Refined Lead
- G. ASTM B 766: Electrodeposited Coatings of Cadmium
- H. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- I. American Iron & Steel Institute (AISI)
- J. American National Standards Institute (ANSI)
- K. American Wire Gauge (AWG)
- L. Illuminating Engineering Society (IES)
- M. Institute of Electrical and Electronics Engineers (IEEE)
- N. Intertek ETL Listed
- O. National Electric Code (NEC)
- P. National Electrical Manufacturers Association (NEMA)
- Q. National Fire Protection Association (NFPA)
- R. Underwriters Laboratories (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Submit for review all manufacturers' parts list, wiring schematics, installation instructions, shop drawings, and maintenance manuals.
- B. Submit for information all manufacturers' warranty and guarantee information, and certifications.
- C. A warranty letter stating that the contractor guarantees the lighting system against all material and installation defects for a period of 6 months.
 - 1. The guarantee periods starts on the date of Substantial Completion.
 - 2. Include in the letter:
 - a. State Project Designation
 - b. State Project Name

- c. Contractor, Provider, and Installer Name
- 3. The guarantee covers 100 percent of the lighting system materials and installation costs.
- 4. Remove and replace lighting system for all failed sections in the event of performance failure.

1.6 QUALITY ASSURANCE

- A. Electrical components must conform to the requirements of the National Electrical Code (NEC).
- B. A licensed Journeyman Electrician must be responsible for and supervise all onsite work related to this Section.

PART 2 PRODUCTS

2.1 CONDUCTORS AND GROUNDING

- A. Refer to Section 16530.

2.2 CONDUIT

- A. Refer to Section 16530.

2.3 POLYMER CONCRETE JUNCTION BOXES

- A. Refer to Section 13554.

2.4 POWER CABLE ROUTE MARKER

- A. Refer to ASTM B 29, alloy 5052-H38. 0.08 inch thick sheet aluminum as specified.
- B. White and red enamel paint – Refer to Section 09972.
- C. Mounting hardware – Refer to Section 05120.
- D. Flanged channel mount post – Refer to Section 02842.

2.5 SPLICE, MOLDED CONNECTOR, AND FUSE HOLDER

- A. Splicing– Wet location type connectors. Refer to Section 16530.

- B. Use spring-loaded, molded connector and fuse holder with 90 percent minimum conductivity according to ANSI/UL 486A. Include an integrated break-away coupling for luminaire pole with slip base h 200,000 A interrupting rating. Refer to UL Class CC.
- C. Light pole fuses with rating according to Table 1.

Table 1

Light Pole Fuses			
Voltage	Wattage	HPS (Amps)	LED (Amps)
120	250/400	20	15
208/240	250/400	15	10
277/480	250/400	10	5

- D. Lighting Circuit Fuses – Refer to UL Class RK5.
- E. Service Disconnect Fuses – Refer to UL Class R.

2.6 POLE – GENERAL

- A. Use tapered steel poles. Refer to SL Series Standard Drawings.
- B. Galvanized according to AASHTO M 111.
- C. Performance Criteria
 - 1. Wind load – Design according to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (Current Edition).
 - 2. Designed for luminaire weight of 77 lb with projected area of 3.0 ft².
 - 3. Maximum allowable deflection of 4¾ inch. Deflection criteria are based on a 100 lb horizontal load applied at 6 inches below shaft top.
- D. Pole Designated for Decorative Lighting
 - 1. Provide a festoon outlet located 16 ft from the base plate with duplex receptacle and weather-proof cover.
 - 2. UL listed.

E. Light Pole Numbers

1. General

- a. Use 3 inch, series C legend, green reflectorized sheeting as specified with 1 inch vertical spacing between letters. The legend reads from top to bottom.
- b. Use 4 inch wide, white reflectorized sheeting as specified for legend backing.
- c. Refer to Standard Specification for Construction and Bridges on Federal Highway Projects (Current Edition) for reflective sheeting.

2. Mainline Lighting

- a. Use mile marker to two decimal places for light pole identification (ID) number and a letter to show which circuit it is attached to.
- b. Example: 3 Light pole at mile marker 302.22
 0
 2
 2
 2
 A

3. Ramp Lighting

- a. Specify the light pole ID number consisting of the following components: the exit number, the general direction of the ramp, collector, or frontage, the light pole number in a series numbered in the direction of travel, and a letter to identify the electrical circuit.
- b. Use the following legend codes:
W = west
F = frontage
N = north
S = south
- c. Example:
3 34 indicates exit number 34, WCN identifies
4 a westbound to northbound collector ramp,
W 2 designates the second pole in a series,
C and the B references the electrical circuit.
N
2
B

F. Light Pole Foundation

- 1. Use drilled shafts according to Section 02466.
 - a. Use Class AA(AE) concrete – Refer to Section 03055.
 - b. Use coated deformed reinforcing steel – Refer to 03211.

2.7 HIGHWAY LUMINAIRE GROUND MOUNTED POLE – MOUNTING HEIGHT 45 FEET AND UNDER

- A. State Furnished Items
 - 1. Luminaire pole with base
 - 2. LED luminaire
 - 3. Luminaire arm or vertical attachment.
 - 4. Anchor bolts
 - 5. Related hardware for this Section, Article 2.7 paragraphs A1 thru A4.

2.8 POLE – MOUNTING HEIGHT OVER 45 FEET (HIGH MAST)

- A. Allowable steel stresses as specified in current AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
 - 1. Refer to ASTM A 572 Grade 50.
 - 2. Meet Fatigue Category I for poles 100 ft or higher and Fatigue Category II for poles under 100 ft.
- B. Steel base-plate – Refer to ASTM A 572 grade 50 or ASTM A 36.
- C. Anchor bolts – Refer to AASHTO M 232, ASTM F 1554, grade 55.
- D. High Mast Service Hoist Assembly
 - 1. Mast head assembly – Provide steel support sheaves for support of hoisting cables.
 - a. Use sheaves with oil-impregnated, sintered-bronze bushings mounted on stainless steel shafts.
 - b. Include mast head cover of galvanized steel or spun aluminum that protects the assembly from weather.
 - 2. Hoisting cables – three $\frac{3}{16}$ inch, 7 x 19 non-rotational stainless steel cables.
 - 3. Luminaire support ring – minimum 10-gauge galvanized or stainless steel ring and 2 inch diameter luminaire arms.
 - a. Mount a weather tight wiring enclosure containing a pre-wired 600 V terminal block with power receptacle for testing luminaries when ring has been lowered.
 - 4. Power cable sheave – brushed with oil-impregnated, sintered-bronze bushings with a stainless steel shaft.
 - 5. Ring centering device – roller-contact, spring-loaded, water-resistant, non-marking roller on stainless steel shaft.
 - 6. Winch – worm gear driven and self-locking with $\frac{1}{4}$ inch, 7 x 19 non-rotational, stainless steel cable.

7. Internal drive motor – UL Listed as heavy duty, reversing, with torque limiter, capable of raising the luminaire support ring at a minimum rate of 15 ft per minute.
8. Latching system– Use a bottom latching system to hold luminaire ring in its raised position.
 - a. Install safety chains for securing the clevis assembly.

2.9 HIGHWAY LUMINAIRE

- A. Physical Requirements
 1. Low-profile, die-cast aluminum housing with white or grey minimum 3 mil powder coat finish.
 - a. Wide angular channels that allow for natural removal of dirt and debris.
 2. 1.5 inch to 2.5 inch O.D. horizontal tenon mount.
 3. Built in bubble level.
 4. High temperature wiring.
 5. Hinged door with tool-less entry.
 6. Large terminal block directly in line with incoming power wires, accommodate up to 6 AWG wire.
 7. Luminaire weight and projected area within design loading limits.
 8. UL 8750 and UL 1598 compliant.
 9. Vibration tested to ANSI C136.31.
 10. ETL Listed for wet locations.
 11. Refer to SL Series Standard Drawings.
- B. LED Driver
 1. Rated for a minimum 70,000 hours.
 2. NEMA IP66 rated.
 3. Voltage as specified. Multi-volt 120 – 277 VAC or 480 VAC.
 4. Built-in 10 kV surge suppression.
- C. LED Optics Chamber
 1. EMA IP66 rated.
- D. Performance Requirements
 1. IES L70 lumen maintenance minimum 70,000 hours.
 2. Apparent color temperature 4000K – 4500 K.
 3. Type II light distribution pattern.
 4. Luminaire Type A
 - a. Minimum 9,000 delivered lumens per IES LM-79.
 - b. Required power – maximum 140 Watts.
 5. Luminaire Type B
 - a. Minimum 14,500 delivered lumens per IES LM-79.
 - b. Required power maximum 230 Watts

2.10 HIGH MAST LUMINAIRE

- A. Physical Requirements
 - 1. Symmetrical or asymmetrical with the asymmetrical capable of 360 degrees rotation.
 - 2. Cast Type 319 aluminum ballast housing with slipfitter mounts adjustable to at least plus or minus 3 degrees.
 - 3. Optical assembly – Open, ventilated, treated aluminum reflector.
 - 4. UL 1572 compliant.
 - 5. Universal or Advance standard ballast with standard capacitor and ignitor. Do not use electronic ballasts or ignitors.
- B. High Pressure sodium ballast
 - 1. Operates at 480 VAC.
 - 2. Refer to ANSI C82.4, C82.6, C92.1, and ANSI/UL 1029.
 - 3. Power Factor must maintain 90 percent for nominal secondary load and a least 70 percent for any 10 percent voltage variation.
 - 4. Lamp Wattage – maintain no more than 5 percent variation.
 - 5. Regulation – maintain no more than 35 percent for 10 percent line-voltage variation.
 - 6. Must start and operate at the rated lamp wattage at ambient temperatures down to -20 degrees F for the rated life of the lamp.
 - 7. Must sustain lamp operation for a minimum of 4 seconds at a voltage dip of 35 percent.
- C. Lamp
 - 1. Philips, Sylvania, General Electric, or approved equivalent 1000 W E-25 lamp with mogul base.
 - 2. Non-cycling characteristics.
 - 3. Rated life of no less than 24,000 hours at 10 hours per start-up.

2.11 UNDERSTRUCTURE LUMINAIRE

- A. Physical Requirements
 - 1. LED or induction lamp fixture, specifically designed for understructure application.
 - 2. Die-cast aluminum housing with vandal-proof fastener.
 - 3. Optical assembly – heat and impact resistant, tempered glass, or prismatic acrylic lens and stainless steel lens guard.
 - 4. Wall mount – minimum 60 degree beam angle.
 - 5. UL 8750 and UL 1598 compliant.
 - 6. Vibration tested to ANSI C136.31.
 - 7. ETL Listed for wet locations.

- B. LED Driver
 - 1. Rated for a minimum 70,000 hours.
 - 2. NEMA IP66 rated.
 - 3. Voltage as specified. Multi-volt 120 – 277 VAC or 480 VAC.
 - 4. Built-in 10 kV surge suppression.
- C. LED Performance Requirements
 - 1. IES L70 lumen maintenance minimum 70,000 hours.
 - 2. Apparent color temperature 4000 K – 4500 K.
 - 3. Minimum 7500 delivered lumens per IES LM-79.
 - 4. Required power – maximum 110 Watts.
- D. Induction Lamp Driver
 - 1. Power Factor– minimum of 90 percent for a 10 percent voltage variation.
 - 2. Lamp Wattage– 150 W – 165 W with no more than 5 percent variation.
 - 3. Regulation– maintain no more than 30 percent for 10 percent line voltage variation.
 - 4. Must start and operate at the rated lamp wattage at ambient temperatures down to 20 degrees F for the rated life of the lamp.
 - 5. Must maintain lamp operation for a minimum of 4 seconds at a voltage dip of 40 percent.
- E. Induction Lamp Performance Requirements
 - 1. Apparent color temperature of 3,500 K to 4,100 K.
 - 2. Rated life of no less than 100,000 hours at 10 hours per start up.

2.12 OVERHEAD SIGN LUMINAIRE

- A. General Requirements
 - 1. LED or induction lamp fixture with die-cast aluminum housing, die-cast aluminum door and integral glare shield.
 - 2. 1¼ inch square conduit clamp support.
 - 3. Photometrics designed specifically for sign illumination.
 - 4. Weight – no more than 40 lb with a projected area of not more than 2.5 ft².
 - 5. Meet all applicable specifications outlined in 2.11 of this Section.
 - 6. LED performance – Minimum 5,000 delivered lumens at a maximum 70 Watts.
 - 7. Induction lamp performance – 70 W to 85 W.

2.13 SERVICE DISCONNECT SWITCH

- A. Refer to Section 16530.

2.14 CONTROL EQUIPMENT

- A. Photocell Control Units
 - 1. Refer to ANSI 136.10, NEMA Base.
 - 2. Fail safe in the “on” position. Turns on at $32 \text{ Lx} \pm 10$ percent.
 - 3. Minimum 12-year warranty.
- B. Lighting Contactor
 - 1. Hermetically sealed, steel tube mercury contacts.
 - 2. Manually operated, mechanically held contact.
 - 3. Remote or photoelectric-operated, magnetic, electrically held contactor.
 - 4. Three position slide selector with “on-off-auto” switch.
- C. Control Relay
 - 1. Refer to ANSI/IEEE C37.13, C37.27 and C62.41.
 - 2. Contact rating of 3,000 W minimum.
 - 3. Normally open.
 - 4. Multiple relay – Zinc/di-chromate-plated magnet, Class B insulation rating coil, cadmium oxide contact, dual expulsion gap lightning arrester and valve type line arrester with no less than 650 V rating.
- D. Enclosure
 - 1. Refer to NEMA 250 Type 3R. Encase in a cabinet with padlock as specified.
- E. Circuit Breaker UL Rated
 - 1. 240 V at 10,000 A interrupting rating
 - 2. 480 V at 14,000 A interrupting rating

2.15 MEDIUM VOLTAGE CONDUCTORS AND TRANSFORMER

- A. Refer to Section 16530.

2.16 HIGHWAY LIGHTING ELECTRICAL SERVICE

- A. Refer to Section 16530.

2.17 CONCRETE AND ASPHALT

- A. Concrete – Class AA (AE). Refer to Section 03055.
- B. Hot Mix Asphalt – Section 02741
- C. Flowable Fill – Section 03575

2.18 HARDWARE

- A. Screws – stainless steel
- B. Nuts, bolts, and washers
 - 1. Galvanized – Refer to AASHTO M 111.
 - 2. Cadmium-plated – Refer to ASTM B 766.
 - 3. Type NS, as specified.
- C. Mounting bands and buckles – stainless steel, $\frac{3}{4}$ inch wide, 0.03 inch thick meeting AISI, Type 201.
- D. Padlock – Master, No. P-848.

PART 3 EXECUTION

3.1 PREPARATION

- A. Comply with the National Electrical Code (NEC)
- B. Coordinate State Furnished Materials with the Engineer.
 - 1. Receive materials at the Department's Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse to schedule a pickup.
 - 2. Receive drop shipment materials at location specified.
- C. Coordinate with utility – refer to Section 16530.
- D. Pothole, locate, or expose any utility that may conflict with drilling, trenching, or boring work associated with placement of highway lighting pole and conduit.

3.2 CONSTRUCT LIGHT POLE FOUNDATION

- A. Install according to Section 02466 and the SL Series Standard Drawings.

3.3 TRENCHING AND DIRECTIONAL BORING FOR CONDUIT

- A. Refer to Section 16530.
- B. Conduit offset from roadway by more than 20 ft may be installed by plowing.

3.4 INSTALL CONDUIT AND JUNCTION BOXES

- A. Refer to Section 16530.

3.5 INSTALL WIRING

- A. Refer to Section 16530.
- B. Install wiring according to NFPA 70.
 - 1. Neatly arrange wiring within items such as cabinets and junction boxes.
- C. Install molded connectors on the cable so that the load side retains the fuse when it is disconnected at the cable's breakaway coupling.
- D. Use compression or bus bar and water seal as specified.
- E. Use dual connection fuse holders in the luminaire pole for continuous circuits. Do not splice wire in junction boxes unless the circuit is split into two separate runs.
- F. Use minimum No. 8 AWG wire in luminaire pole.

3.6 INSTALL LUMINAIRES AND BALLASTS

- A. Clean all light control surfaces, refractors, and reflectors immediately before installation to provide the maximum lumen output possible.
 - 1. Clean according to the luminaire manufacturer's recommendations.
- B. Adjust luminaires with a level.
- C. Adjust sign bridge luminaires for optimum and uniform light distribution.
- D. High mast luminaire – Obtain manufacturer's certification that the service hoist operation is correctly installed.

3.7 INSTALL POWER SOURCE CONNECTION

- A. Lighting pedestal – Refer to SL Series Standard Drawings. Install according to manufacturer's recommendations.
- B. Service Disconnect Switch
 - 1. Install the grounded neutral conductor from secondary power source to the switch box.

2. Install mounting bracket within 1 ft of both top and bottom of the switch box and within 3 ft of other cabinet or fitting.
3. Provide and install material required by the appropriate power company.
4. Install padlock on the switch box door and handle.

3.8 INSTALL MEDIUM VOLTAGE TRANSFORMER

- A. Refer to Section 16530.
- B. Refer to SL Series Standard Drawings.
- C. Coordinate work with local power company.
- D. Locate foundation in a well drained area.
- E. Dig a trench and backfill for the primary power cable.
- F. Install padlocks on doors.

3.9 PHOTO-ELECTRIC CONTROL

- A. Adjust to "North Sky" position.

3.10 POLE

- A. Refer to SL Series Standard Drawings.
- B. Center the shaft top over the center of the foundation after the arm extension, luminaire, and all accessories are in place or according to the manufacturer's requirements.
- C. Install pole identification numbers at a 45 degree angle to approaching traffic.
 1. Remove old identification numbers without damage to galvanizing.
- D. Torque
 1. Anchor bolts to 118 lbf-ft.
 2. Slip bolts to 80 lbf-ft, release, and re-torque to 70 lbf-ft.
- E. Installing Items on a Pole
 1. Do not drill steel pole.
 2. Use stainless steel mounting bands.
- F. Bond metal pole to concrete encased grounding electrode. Refer to Section 16530.

3.11 TESTING

- A. Continuity of grounding conductor to maintain 1,000 watt load at circuit ends maintaining 95 percent of supply voltage.
- B. Test for conductor insulation integrity – refer to Section 16530.

3.12 SALVAGE

- A. Remove equipment to be reused or salvaged carefully so that it remains in the condition existing before its removal.
- B. Pole assembly remains the property of the Department.
 - 1. Transport to the location specified.
- C. Remove foundation to a depth of 12 inches below the existing surface and backfill with local material.
- D. Remove and discard abandoned junction boxes.
 - 1. Backfill with local material and compact to match adjacent grade.

END OF SECTION

SECTION 16526

ELECTRICAL WORK BRIDGES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Bridge electrical work.

1.2 RELATED SECTIONS

- A. Section 16530: Electrical Power

1.3 REFERENCES

- A. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- B. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- C. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- D. ASTM B 766: Electrodeposited Coatings of Cadmium
- E. American Wire Gauge (AWG)
- F. Electronic Industries Association (EIA)
- G. National Electric Code (NEC)
- H. National Electrical Manufacturers Association (NEMA)
- I. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Working Drawings
 - 1. Detailed shop drawings of all fabricated materials for approval.

PART 2 PRODUCTS

2.1 ELECTRICAL EQUIPMENT

- A. Use equipment conforming to the applicable standards:
 - 1. National Electrical Manufacturer's Association (NEMA)
 - 2. Underwriters Laboratories, Inc. (UL)
 - 3. Electronic Industries Association (EIA)
 - 4. Any local ordinances

2.2 ANCHOR BOLTS, WASHERS, AND NUTS

- A. Light Poles
 - 1. Refer to ASTM A 307.
 - 2. Hot-dip galvanize after fabrication. Refer to ASTM A 153.
- B. Other Bolts and Anchors
 - 1. Refer to ASTM A 307.
 - 2. Electro-plated cadmium. Refer to ASTM B 766.

2.3 CONDUIT AND FITTINGS

- A. Schedule 40 PVC conduit and fittings. Refer to Section 16530.
- B. Rigid metal conduit and fittings as specified when the conduit is attached to the exterior surface of the structure. Refer to Section 16530.

2.4 JUNCTION BOXES

- A. Use hot dip galvanized cast iron junction boxes of standard manufacture, free of honey comb and other defects, approved by UL as watertight, and suitable for outdoor use for high voltage applications. Refer to AASHTO M 55.
- B. Use boxes a minimum of 12 x 8 x 6 inches or the size and type shown on the plans.
- C. Hold the cover rigidly in place by screws or bolts manufactured of a non-corrosive material.

2.5 WORKMANSHIP

- A. Conform to the requirements of the National Electric Code (NEC) and any local ordinances that may apply.

- B. Place the anchor bolts accurately. Do not bend the anchor bolts or ream the holes in the base plate.

2.6 FUTURE USE PULL WIRE

- A. Install No. 14 AWG THHN wire for future use as pull wire for mule tape in all conduit segments.
- B. Provide 3 ft of slack coiled in the junction box measured from the top of the junction box going out.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 16530

ELECTRICAL POWER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical power conduit, conductors, and equipment for electrical services and feeders.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

- A. ASTM B 3: Soft or Annealed Copper Wire
- B. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. ASTM B 496: Compact Round Concentric-Lay-Stranded Copper Conductors
- D. ASTM B 800: 8000 Series Aluminum Alloy Wire for Electrical Purposes—Annealed and Intermediate Tempers
- E. ASTM B 801: Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
- F. ASTM D 92: Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- G. ASTM D 2241: Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- H. ASTM D 2247: Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity
- I. ASTM F 2160: Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)
- J. American National Standards Institute (ANSI)
- K. American Wire Gauge (AWG)

- L. Association of Edison Illuminating Companies (AEIC)
- M. Electric Utility Service Equipment Requirements Committee (EUSERC)
- N. Institute of Electrical and Electronics Engineers (IEEE)
- O. Insulated Cable Engineers Association (ICEA)
- P. Intertek Electrical Testing Labs (ETL)
- Q. National Electric Code (NEC)
- R. National Electrical Contractors Association (NECA)
- S. National Electrical Manufacturers Association (NEMA)
- T. National Fire Protection Association (NFPA)
- U. State of Utah Administrative Rule R930-7 – Accommodation of Utilities and the Control and Protection of State Highway Rights of Way
- V. Underwriters Laboratories (UL)
- W. Western Underground Committee Guides

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

- A. Manufacturer's product data sheets and installation instructions for the following products:
 - 1. Conduit
 - 2. Power and grounding conductors
 - 3. Disconnect switches
 - 4. Panelboards
 - 5. Dry type transformers
 - 6. Pad mounted oil filled transformers
 - 7. Electrical service equipment
 - 8. Medium voltage cables
 - 9. Medium voltage terminations
- B. Test results. Refer to this Section, Article 3.8.
- C. Manufacturer's warranties and guarantees before substantial completion.

1.6 QUALITY ASSURANCE

- A. Electrical components must be listed and labeled as defined in the NEC by a nationally recognized testing agency and must be marked for intended use.
- B. A Master or Journeyman Electrician licensed in the State of Utah must supervise and be responsible for all onsite work related to this Section.
- C. Comply with NFPA 70 (NEC).

PART 2 PRODUCTS

2.1 CONDUCTORS RATED 600 V AND LESS

- A. Material: Stranded copper unless stranded aluminum conductors are specifically identified.
 - 1. Copper: Single conductor, soft drawn complying with NEMA WC70/IECA S-95-658, ASTM B 3 and ASTM B 8.
 - 2. Aluminum: Series 8000, single conductor complying with NEMA WC70/IECA S-95-658, ASTM B 800 and ASTM B 801.
 - a. Do not use aluminum conductors in any traffic signal circuits.
- B. Insulation: 90 degrees C, wet location, cross linked polyethylene, USE-2/RHW-2; resistant to oil, gasoline and sunlight.
- C. Provide conductor sizes as shown with the following minimum sizes:
 - 1. 10 AWG copper conductor.
 - 2. 6 AWG aluminum conductor.

2.2 MEDIUM VOLTAGE CABLES

- A. Cable type: MV105 complying with UL 1072, AEIC CS 8, NEMA WC74/IECA S-93-639, IECA S-97-682, ASTM B 8 and ASTM B 496.
- B. Conductor material: stranded copper, compact round, concentric lay, Class B.
- C. Insulation: Ethylene-propylene rubber with the following characteristics:
 - 1. 5kV or 15kV voltage rating as shown
 - 2. 133 percent insulation level
 - 3. Ethylene content of the elastomer used in the insulation compound not exceeding 72 percent by weight
 - 4. Polyethylene free insulation compound

5. 5-mil copper tape shielding helically applied over semiconducting insulation shield with minimum 12.5 percent overlap wrap
6. Sunlight-resistant PVC cable jacket

2.3 GROUNDING CONDUCTORS

- A. Material: Stranded copper unless stranded aluminum conductors are specifically identified.
 1. Copper: Single conductor, soft drawn complying with NEMA WC70/IECA S-95-658, ASTM B 3 and ASTM B 8.
 2. Aluminum: Series 8000, single conductor complying with NEMA WC70/IECA S-95-658, ASTM B 800 and ASTM B 801.
 - a. Do not use aluminum conductors in any traffic signal circuits.
- B. Insulation: 90 degrees C, wet location, cross linked polyethylene, USE-2/RHW-2; resistant to oil, gasoline and sunlight.
- C. Provide conductor sizes as shown with the following minimum sizes:
 1. 10 AWG copper conductor.
 2. 6 AWG aluminum conductor.

2.4 GROUND RODS

- A. Provide copper clad steel ground rods of 3/4 inch diameter by 10 ft long.
 1. Ground Rod Clamps: Bridgeport IGBC075 or equivalent.

2.5 CONDUIT

- A. Schedule 40 PVC, type EPC-40, rated for use with 90 degrees C conductors. Comply with NEMA TC-2, ASTM D 2241, UL 651 Listed.
 1. Fittings complying with NEMA TC-3.
- B. Schedule 80 PVC, type EPC-80, 90 degrees C rated. Comply with NEMA TC-2, ASTM D 2241, UL 651 Listed.
 1. Fittings complying with NEMA TC-3.
- C. Schedule 40 High Density Polyethylene (HDPE), type EPEC-40, smoothwall, 90 degrees C rated. Comply with ASTM D 2247, ASTM F 2160, NEMA TC-7; Intertek ETL Listed to UL 651.
- D. Schedule 80 High Density Polyethylene (HDPE), type EPEC-80, smoothwall, 90 degrees C rated. Comply with ASTM D 2247, ASTM F 2160, NEMA TC-7; Intertek ETL listed to UL 651.
- E. Rigid Metal Conduit (RMC) complying with UL-6. Zinc galvanized exterior coating complying with ANSI C80.1.

- F. Liquidtight Flexible Metal Conduit (LFMC), -30 degrees C to 80 degrees C rated, UL 360 listed.
- G. Liquidtight Flexible Nonmetallic Conduit (LFNC), 80 degrees C dry, 60 degrees C wet rated, sunlight resistant, UL 1660 listed.

2.6 TERMINATION CONNECTIONS

- A. Wet location connectors
 - 1. Supply multiport submersible connectors.
 - a. Ethylene propylene diene monomer rubber insulated, AL/CU and submersion rated.
 - b. Tested to ANSI 119.1, ANSI 119.4 and Western Underground Committee Guide 2.5.
 - c. Port quantity and conductor size range matching requirements at each application location.
 - 2. Heat shrink tubing: Thick wall polyolefin tubing with factory applied heat activated adhesive, 3:1 shrink ratio, UL 486D listed.
- B. Dry location connectors
 - 1. Twist on type wire connectors listed to UL 486C may be used on AWG 8 and smaller conductors.
 - 2. Insulated multiport mechanical connectors.
 - a. Aluminum alloy connector block rated AL/CU with port quantity and entry configuration to match location requirements.
 - 3. Vinyl electrical tape: 8.5 mil, UL 510 listed vinyl electrical tape.

2.7 MEDIUM VOLTAGE TERMINATIONS

- A. Solid terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable.
 - 1. Include shield ground strap for shielded cable terminations.
 - 2. Class 1 terminations: modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
 - 3. Class 1 terminations: heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
 - 4. Class 1 terminations: modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.

- B. Separable insulated connectors: modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
 - 1. Terminations at distribution points: modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
 - 2. Load-break cable terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated.
 - a. Include test point on terminator body that is capacitance coupled.
 - 3. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated.
 - a. Include test point on terminator body that is capacitance coupled.

2.8 DISCONNECT SWITCHES

- A. Fusible switches
 - 1. Type HD, heavy duty, single throw, UL 98 and NEMA KS 1, with clips or bolt pads to accommodate indicated fuses, lockable handle, and interlocked with cover in closed position.
 - 2. Internally mounted grounding and insulated neutral buses labeled for copper and aluminum ground conductors.
 - 3. Stainless steel, NEMA 250 Type 4X enclosure rating.
- B. Nonfusible switches
 - 1. Type HD, heavy duty, single throw, UL 98 and NEMA KS 1, lockable handle, and interlocked with cover in closed position.
 - 2. Internally mounted grounding and insulated neutral buses labeled for copper and aluminum ground conductors.
 - 3. Stainless steel, NEMA 250 Type 4X enclosure rating.
- C. Enclosed Molded Case Circuit Breakers
 - 1. Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
 - 2. Thermal-Magnetic trip unit with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
 - 3. Internally mounted grounding and insulated neutral buses labeled for copper and aluminum ground conductors.
 - 4. Stainless steel, NEMA 250 Type 4X enclosure rating.

2.9 PANELBOARDS

- A. Feeder and branch circuit panelboards: comply with NEMA PB-1.
 - 1. Phase, neutral, and ground buses made of hard-drawn copper, 98 percent conductivity.
 - 2. Equipment ground bus sized adequately for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Stainless steel, NEMA 250 Type 4X enclosure rating.
- B. Main overcurrent protective device: Bolt on molded case circuit breaker, complying with UL 489, NEMA AB 1, and NEMA AB 3, with 10kA minimum interrupting capacity or higher as needed for the available fault current.
 - 1. Thermal-Magnetic trip unit with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- C. Branch circuit overcurrent protective devices: Bolt-on circuit breakers, AL/CU rated, replaceable without disturbing adjacent units.
 - 1. Comply with UL 489, with 10kA minimum interrupting capacity or higher as needed for the available fault current.

2.10 DRY TYPE TRANSFORMERS

- A. Comply with NEMA ST 20, listed and label as complying with UL 1561.
- B. Coil Material: Resin encapsulated copper or aluminum
- C. Enclosure: Stainless steel, NEMA 250 Type 3R or 4X, fully enclosed, non-ventilated
- D. Insulation Class: 220 degrees C, UL-component-recognized insulation system with a maximum of 115 degrees C rise above 40 degrees C ambient temperature
- E. Primary and secondary voltage as shown

2.11 PAD MOUNTED OIL FILLED TRANSFORMER

- A. Description: ANSI C57.12.00, ANSI C57.12.13, IEEE C57.12.25, pad-mounted, 2-winding transformers.
 - 1. Stainless-steel tank base and cabinet.
- B. Coil Material: Copper.

- C. Insulating Liquid: Less flammable, edible-seed-oil based and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 degrees C when tested according to ASTM D 92.
 - 1. Biodegradable and nontoxic.
- D. Temperature Rise: 65 degrees C when operated at rated kVA output in a 40 degrees C ambient temperature.
- E. Basic Impulse Level: 95 kV.
- F. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use.
- G. Equipment support pad – Refer to SL Series Standard Drawings.

2.12 HIGHWAY LIGHTING ELECTRICAL SERVICE

- A. General Requirements
 - 1. Provide product manufactured by one of the following:
 - a. Millbank Manufacturing Co.
 - b. Myers Power Products
 - c. Cooper Industries
 - d. Approved equal product.
 - 2. Metered power pedestal with base, NEMA 3R cabinet with gasket sealed access doors fabricated of 0.120 inch minimum thickness anodized aluminum.
 - a. Continuously welded exterior cabinet and door seams with smooth seams and free of any voids.
 - b. Design to be bolted down to a concrete foundation or pad from the inside of the pedestal.
 - 3. Cabinet height 54 inches maximum.
 - 4. Provide service entrance, meter, and distribution compartments separated by corrosion resistant barrier.
 - 5. Provide compartment access doors with stainless steel piano hinges with hinges on left as viewed facing the cabinet.
 - 6. Provide provision for padlock.
 - 7. Design cabinet openings including ventilation holes to prevent entrance of insects such as wasps, hornets, bees, and varmints when access panel and doors are closed.
 - a. Install a permanent welded insect screen on ventilation holes.
 - 8. Provide sealed windows made of shatter resistant polycarbonate for photocell operation.
 - a. Provide two windows and mounting brackets on opposite sides of the cabinet for the photocell.

- b. Locate the windows on the sides of the cabinet.
- 9. UL 508 listed.
- 10. Provide pedestal documentation permanently attached to the inside of the distribution section.
- 11. Provide interior and exterior labels etched or engraved and mechanically fastened to the cabinet.
 - a. Adhesives are not acceptable.
 - b. Label front exterior of the cabinet "UDOT LIGHTING DISCONNECT."
- 12. Minimum 6 inches of free space between pad and any electrical components for routing conductors.

B. Electrical Requirements

- 1. Rated for 200 amp, 1-phase, 3-wire, 120/240V or 240/480V service as shown.
 - a. 200 amp utility landing lugs rated for copper and aluminum conductors, sized to accommodate up to 250 kCMIL wire.
 - b. Self-contained utility watt-hour meter socket with manual link bypass.
 - 1) Comply with local power utility company requirements.
 - c. Bolt on 200-amp, 2-pole main circuit breaker.
 - d. 12 circuit panel board interior.
 - e. Lighting contactors, electrically held, 30-amp, 2-pole, rated for No. 2 AWG wire.
 - 1) Provide one contactor per lighting circuit.
 - f. Pre-wired photocell socket and 12 year warranty photocell module.
 - g. Test switch with Hand-Off-Auto settings.
 - h. Circuit terminal bar with lugs rated for wire sizes #6 to #0 AWG.
 - i. Grounding terminal bar with lugs rated for #6 AWG wire size, adjacent to circuit terminal bar.
 - j. Position circuit and grounding terminal bars to be lowest electrical component and a minimum 12 inches from the cabinet mounting pad.
- 2. Pre-wired complying with to NEC and NEMA requirements using UL listed copper XHHW-2 or UL listed equivalent cable bussing, fully rated.
- 3. UL listed, bolt-on circuit breakers, AL/CU labeled, industrial grade.
 - a. Rated for available short circuit current with minimum interrupting rating of 10k AIC for 240V and 14k AIC at 480V.
- 4. Comply with EUSERC requirements for all mounting hardware and installation details.

2.13 TRAFFIC SIGNAL ELECTRICAL SERVICE

- A. Refer to SL Series Standard Drawings.
- B. Provide product manufactured by one of the following:
 - 1. Millbank Manufacturing Co.
 - 2. Myers Power Products
 - 3. Cooper Industries
 - 4. Approved equal product.
- C. Single meter underground service pedestal
 - 1. Service Disconnect:
 - a. Provide pedestal rated for 100 amp, 1-Phase 3-wire 120/240V service.
 - b. Provide 200 amp utility landing lugs rated for 250 kCMIL wire.
 - c. Provide pedestal that is split into an “un-metered” and a “metered” side.
 - d. Provide plug in circuit breakers that are UL approved, industrial grade, and rated for 10K AIC minimum or higher as required for available fault current.
 - e. Provide one double pole 70 amp main circuit breaker labeled “Metered Main” and one single pole 30 amp circuit breaker labeled “Traffic Signal” with minimum capacity for four metered single pole circuit breakers.
 - 1) Provide traffic signal circuit breaker that is secondary to the metered main breaker.
 - f. Provide cabinet with sealed windows of shatter resistant Lexan or equivalent.
 - g. Provide a meter that can be read from the front of the cabinet.
 - h. Provide pedestal with service entrance, meter, and distribution compartments with a corrosion resistant barrier to separate each compartment.
 - 1) Provide access panel or door with stainless steel piano hinges.
 - i. Provide one double pole 50 amp main circuit breaker labeled “Un-metered Main” and one double pole 20 amp circuit breaker labeled “Lighting” with minimum capacity for four un-metered double pole circuit breakers.
 - 1) Provide lighting circuit breaker that is secondary to the un-metered main circuit breaker.
 - 2. Provide pedestal that is pre-wired according to NEC and NEMA specification with UL approved copper XHHW-2 cable bussing, fully rated.

3. Provide provisions for terminating to a ground rod.
 4. Provide pedestal with UL 508 rating.
 5. Provide self-standing NEMA 3R cabinet (direct burial pedestals are not acceptable) with gasket in place, fabricated of 0.120 inch minimum thickness anodized aluminum.
 - a. Provide all exterior components that are rust proof.
 - b. Provide exterior that has no exposed hardware except for handles.
 6. Meet EUSERC requirements for all mounting hardware and installation details.
 - a. Fit with EUSERC approved power meter base with manual link bypass.
 7. Provide documentation that is permanently and conveniently attached and includes the manufacturer's name, address, phone number, a wiring diagram, date of manufacture, and all necessary information to order an identical pedestal and replacement parts.
 8. Provide labels that are permanently etched or engraved and mechanically fastened to the cabinet.
 - a. Adhesives are not acceptable.
 - b. Label the front exterior of the cabinet "UDOT SIGNAL AND LIGHTING DISCONNECT."
- D. Dual meter underground service pedestal
1. Pedestal height 54 inches maximum and 24-inch minimum width.
 2. Provide rainproof, NEMA 3R cabinet.
 3. Cabinet constructed of 0.125 inch anodized aluminum 5052-H32 or 16 gauge #306 stainless steel, continuously welded or overlapped and carriage-bolted exterior and door seams, smooth and free of any voids.
 4. Provide two meter sockets, one labeled "SIGNAL" and one labeled "LIGHTING."
 5. Design cabinet openings, such as ventilation holes, to prevent entrance of insects such as wasps, hornets, or bees.
 - a. Install a permanent, welded insect screen over ventilation holes.
 6. Provide adequate clearances inside the cabinet for pulling and connecting to service and distribution (field) wiring with conduits extending into the cabinet 2 inches maximum.
 7. Provide sealed shatter and UV resistant polycarbonate windows for meter reading and photocell operation.
 - a. Meter window on front of pedestal.
 - b. Photocell headlight shield that will not affect normal operation nor will harbor nesting insects.

8. Provide service entrance, meter, and distribution compartments with padlockable, vandal-resistant doors and covers, and corrosion resistant barriers separating each compartment.
 - a. Design compartments for safety and ease of maintenance.
 - b. Hinge access panels and doors with stainless steel piano hinges on access panel or access door.
 - 1) Place hinges on left side of door when facing the pedestal.
9. Fasten cabinet directly to pad-mount base encased in concrete, with option for attachment to anchor bolts. Secure all mounting bolts from inside the cabinet.
10. Permanent etched or engraved labels mechanically fastened to the cabinet. Adhesives are not acceptable.
 - a. Label Exterior of front-door "UDOT SIGNAL AND LIGHTING DISCONNECT."
11. Conform to UL508 Industrial Control Panel Labels for service entrance equipment requirements.
12. Provide 30A, 125VAC, 2-pole, 3-wire, and twist-lock flanged inlet type L5-30P with weatherproof padlockable cover to be used for generator attachment during power outages.
13. Provide documentation permanently and conveniently attached to the inside of the distribution section or a permanently attached interior documentation storage pocket or pouch.
 - a. Include the manufacturer's name, address, phone number, a wiring diagram, date of manufacture, and all necessary information to order an identical pedestal and replacement parts in the documentation.
14. Provide single-phase, 3-wire, 120V/240V, 100A service.
15. Utility terminations rated for 200A and lugs sized for 250 kCMIL wire with two self-contained watt-hour meter sockets, main service disconnect, and meter bypass switch.
 - a. Meet local power utility company requirements.
 - b. Provide adequate space for a meter puller.
16. Electrical components rated for temperatures between -30 degrees F and 130 degrees F.
17. Meet EUSERC requirements for all mounting hardware and installation details.
18. Provide plug in circuit breakers that are UL approved, industrial grade, and rated for 10K AIC minimum or higher as required for available fault current.
19. Metered Signal Side requirements:
 - a. Double pole 70-amp main plug-in circuit breaker labeled "Signal Main."
 - b. One single-pole 30-amp plug-in circuit breaker labeled "Traffic Signal," secondary to the Signal Main breaker.

- c. Capacity for 4 single pole plug-in circuit breakers, also secondary to Signal Main breaker.
 - d. Provide pre-wired 30-amp generator input bypass, rotary cam transfer switch, with exterior generator twistlock plug L5-30P for use during power outage. Label transfer switch settings "LINE" and "GEN." Feed the generator bypass through the signal side of the breaker panel only.
20. Metered Lighting Side requirements:
- a. Double Pole 70-amp main plug-in circuit breaker labeled "Lighting Main."
 - b. Double pole 30-amp (120/240 volt) plug-in circuit breaker labeled "lighting," plus breaker for photo control, both secondary to the Lighting Main breaker.
 - c. Pre-wired 30-amp 120V electrically-held 2-pole contactor.
 - d. Three-position rotary test switch with "On-Off-Auto" settings, clearly labeled.
 - e. Minimum capacity for (4) four double-pole circuit breakers.
 - f. Circuit terminal bar with lugs rated for wire sizes 6 AWG to 1/0 AWG, labeled "Lighting Circuit." Grounding terminal bar with lugs rated for 6 AWG to 1/0 AWG wire size, adjacent to circuit terminal bar.
 - g. Prewired for photocell.

2.14 ATMS ELECTRICAL SERVICE

- A. General Requirements
- 1. Provide product manufactured by one of the following:
 - a. Millbank Manufacturing Co.
 - b. Myers Power Products
 - c. Cooper Industries
 - d. Approved equal product.
 - 2. Metered power pedestal with base, NEMA 3R cabinet with gasket sealed access doors fabricated of 0.120 inch minimum thickness anodized aluminum.
 - a. Continuously welded exterior cabinet and door seams with smooth seams and free of any voids.
 - b. Design to be bolted down to a concrete foundation or pad from the inside of the pedestal.
 - 3. Cabinet height 54 inches maximum.
 - 4. Provide service entrance, meter, and distribution compartments separated by corrosion resistant barrier.
 - 5. Provide compartment access doors with stainless steel piano hinges.
 - a. Hinges on left as viewed facing the cabinet.
 - 6. Provide provision for padlock.

7. Design cabinet openings including ventilation holes to prevent entrance of insects such as wasps, hornets, bees, and varmints when access panel and doors are closed.
 - a. Install a permanent welded insect screen on ventilation holes.
 8. UL 508 listed.
 9. Provide sealed shatter-resistant and UV-resistant polycarbonate windows for meter reading on front of meter pedestal.
 10. Provide pedestal documentation permanently attached to the inside of the distribution section.
 11. Provide interior and exterior labels etched or engraved and mechanically fastened to the cabinet. Adhesives are not acceptable.
 - a. Label front exterior of the cabinet "UDOT ATMS DISCONNECT."
- B. Electrical Requirements
1. Rated for 100-amp, 1-phase, 3-wire, 120/240V service.
 - a. 200 amp utility landing lugs to accommodate up to 250 kCMIL wire rated for copper and aluminum conductors.
 - b. Main breaker: bolt on 100-amp, 2-pole.
 - c. 12 circuit panel board interior.
 2. Pre-wired complying with NEC and NEMA requirements using UL listed copper XHHW-2 or UL listed equivalent cable bussing, fully rated.
 3. Circuit breakers: UL listed, plug-in, AL/CU labeled, industrial grade, and rated for available short circuit current with minimum interrupting rating of 10k AIC at 240V.
 4. Meet EUSERC requirements for all mounting hardware and installation details.
 5. Fit with EUSERC approved power meter base with manual link bypass.

2.15 CONDUCTOR IDENTIFICATION MATERIALS

- A. Colored, 7 mil thickness, self-adhesive vinyl electrical tape complying with UL 510.
- B. Polyethylene or weather resistant nylon 6.6 flag or wrap type cable marker.
1. Tag area is markable with manufacturer's permanent marker or machine printed, laminated label.

PART 3 EXECUTION

3.1 INSTALLATION STANDARDS

- A. Comply with NFPA 70 (NEC).

3.2 PREPARATION

- A. Comply with local power utility requirements.
 - 1. Contact power utility at least 60 days before the connection date and verify the exact location, voltage, procedure, and materials required by the power utility.

3.3 TRENCHING AND DIRECTIONAL BORING FOR CONDUIT

- A. Trenching Paved Asphalt Surface
 - 1. Do not use backhoe.
 - 2. Make the trench 6 inches wide or less.
 - 3. Use flowable fill to within 3 inches of the existing roadway surface unless otherwise specified.
 - 4. Apply tack coat evenly before final backfill when placing HMA.
 - 5. Match the composition, density, and elevation within $\pm \frac{3}{16}$ inch of the existing pavement section.
- B. Trenching Unpaved Surface
 - 1. Use backfill that matches the composition, density, and elevation within $\pm \frac{3}{16}$ inch of the existing surface.
 - 2. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by jacking, drilling, or pushing.
 - 3. Dispose of surplus material promptly.
- C. Minimum Conduit Cover
 - 1. Traffic Signals
 - a. Refer to SL series standard drawings.
 - 2. All others
 - a. Refer to AT series standard drawings.
 - b. Refer to Utah Administrative Rule 930-7
- D. Directional Boring
 - 1. Directional boring is an approved alternative to trenching unless otherwise specified.
 - 2. Immediately contain, remove, and properly dispose of all drilling fluid outside the bore.

3.4 INSTALL CONDUIT

- A. Use rigid metal conduit or Schedule 80 PVC conduit for above ground application.
 - 1. Liquidtight Flexible Metal Conduit or Liquidtight Flexible Non-Metallic Conduit is permitted in lengths not exceeding 6 ft where not subject to physical damage.
 - 2. Apply corrosion protection to any portion of rigid metal conduit buried in the ground or encased in concrete.
- B. Use PVC or HDPE conduit for underground application.
- C. Install a bushing or bell end adapter at ends of all conduit.
- D. Seal uncapped conduit ends inside junction box
 - 1. Conduit 2 inches and smaller: Seal with at least 2 inches of duct caulking or PVC cap.
 - 2. Conduit larger than 2 inches: Seal with duct plug or PVC cap.
- E. Do not use a torch for bending or shaping PVC conduit.
 - 1. Use equipment specifically designed to heat PVC conduit to shape any required curves or radii.
- F. Use couplers specifically designed to couple PVC conduit to HDPE conduit.
- G. Install weatherproof junction box with breakaway receptacle or fuse holder at breakaway structures.
- H. Do not exceed 270 degrees of conduit sweeps between individual junction boxes.
- I. Route conduit entering junction boxes to enter on the narrow side at an angle perpendicular to the box.
 - 1. Run conduit to the junction box by the most direct route, using the fewest bends possible.

3.5 INSTALL CONDUCTORS

- A. Verify conduit is clean, dry, and free of dirt and debris before installing conductors.
- B. Use conductor manufacturer approved pulling compound or lubricant where necessary.
 - 1. Compound used must not deteriorate conductor or insulation.
- C. Do not exceed manufacturer's recommended maximum pulling tensions.
- D. Install equipment grounding conductor in all conduits.
 - 1. Copper grounding conductors must run continuously between and be bonded to ground rods in each junction box.
 - 2. Aluminum grounding conductors must run continuously between junction boxes, and be bonded to the ground rod in each junction box using a 48 inch insulated copper pigtail conductor.
 - a. Match copper pigtail gauge to aluminum grounding conductor gauge.
- E. Install conductors from source to load in continuous lengths without splicing.
- F. Terminate conductors.
 - 1. Use wet location connectors in wet locations including all underground and in-ground locations,.
 - 2. Dry location twist type connectors may be used in dry above ground locations.
 - 3. Do not use vinyl electrical tape as the sole means of insulating a connection or connector.
- G. Identify each conductor by circuit, phase, voltage, source and load.
 - 1. Conductors 6 AWG and smaller must have continuous outer insulation color complying with NEC requirements.
 - 2. Conductors 4 AWG and larger may be identified by use of colored phase tape at all junction boxes and terminations.
 - 3. Group all conductors of each circuit using wrap around or flag type cable markers.
 - a. Identify source and load location by description and milepost.
 - b. Do not use Station Numbers to describe location.
- H. Leave 6 ft of slack conductor measured from the opening of each junction box that the conductor passes through.

- I. Make aluminum conductor connections in accordance with NECA 104.
- J. Neatly arrange and support conductors within cabinets, junction boxes, and fixtures.

3.6 GROUNDING AND BONDING

- A. Bond equipment grounding conductors to ground rods, metal equipment enclosures, metal poles and ground busses.
 - 1. Comply with NEC Article 250 requirements.
- B. Bond neutral conductors to metal equipment enclosures and equipment grounding conductors only at electrical service equipment and at transformer secondary terminals and other separately derived systems.
 - 1. Comply with NEC Article 250 requirements.
- C. Install concrete encased electrodes where shown and as required by the NEC. Bond existing concrete encased electrodes such as pole anchor bolts to metal pole or equipment enclosures and equipment grounding conductor.
 - 1. Concrete encased electrode consists of: Conductive metal in structure foundation encased by at least 2 inches of concrete where foundation is in direct contact with the earth. Use one of the following conductive metal elements:
 - a. 4 AWG bare copper conductor, 20 ft minimum length.
 - b. Bare or zinc galvanized steel reinforcing bars or anchor bolts, 1/2 inch minimum diameter; 20 ft total length.
 - 1) Connect lengths of bar together with steel tie wires to meet total length requirement.
 - 2) Epoxy coated reinforcing bar may not be used as part of the grounding electrode.
 - c. No additional conductive metal is required in the concrete foundation where anchor bolts or other conductive metal satisfies requirements above.
- D. Install ground rods where shown and as required by the NEC.
 - 1. Drive ground rods until tops are 2 inches below final grade at services and separately derived systems.
 - 2. Install ground rod to extend a minimum of 4 inches and a maximum of 6 inches above box floor in junction boxes.
 - 3. Space ground rods minimum of 6 feet apart where multiple rods are shown or are required by the NEC.
 - 4. Provide 48 inch copper jumper from ground rod to aluminum equipment grounding conductor.

3.7 INSTALL DISCONNECTS, PANELBOARDS AND TRANSFORMERS

- A. Install equipment level and plumb. Securely mount equipment to support frames.
- B. Install rain shields and verify drain openings are unblocked.
- C. Close and seal any unused openings.
- D. Install fuses in fusible devices.
- E. Provide and install one-time use locks on all lockable equipment.
 - 1. Install State furnished padlocks where provided.

3.8 TESTING

- A. After installation but before terminating test each conductor for insulation integrity to adjacent conductors and ground using 1000VDC megohmmeter.
 - 1. Record insulation resistance in megohms after 30 seconds and 60 seconds (R30 and R60).
 - 2. Calculate polarization index by dividing the 60 second resistance by the 30 second resistance ($R60 / R30$).
 - 3. Replace any conductors with a polarization index value less than 1.4.
- B. Measure transformer secondary voltage while loaded to final load and record voltage and submit for information.
- C. Record insulation test resistance values, polarization index and transformer voltage measurements and submit for information.

END OF SECTION

End of 2017 Standard Specifications

For Road and Bridge Construction