Utah Department of Transportation

2008 Standard Specifications

FOR ROAD AND BRIDGE CONSTRUCTION

U.S. Standard Units (Inch-Pound Units)

January 1, 2008

Introduction

This book is a compilation of Standard Specifications for use in Department construction contracts. These specifications incorporate all Supplemental Specifications approved for the 2005 specification book from 2005 - 2007.

The Standard Specifications are written to the Contractor. The Specifications define the Contractor's responsibility in each specification, the Department's expectations, and explain what the Contractor is expected to provide. 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 on the Web site at:
http://www.udot.utah.gov/go/standardsandspecifications

All Web references within sections of these Standards refer to the common Web site of http://www.udot.utah.gov/go/standardsreferences. Refer to this page to see a listing of appropriate Web sites.

All references including AASHTO and ASTM refer to the current version at time of award unless specified otherwise.

Layout

The layout of each specification is as follows:
SECTION NUMBER
TITLE
PART (For example, 1, 2, and 3)
ARTICLE (For example, 1.1, 1.2, 2.1, 2.2, 3.1, and 3.2)
Paragraph (For example A, B, C under an article)

Example:

PART 1	GENERAL				
1.1	ARTICLE				(First level)
	A.	Paragraph			(Second level)
		1.	Subparagraph		(Third level)
			a.	Subparagraph	(Fourth level)
				1) Subparagraph	(Fifth level)

Page Numbering

The Table of Contents, Standard Sections, and Index of this book each have separate numbering systems. The Standard Sections are also numbered individually above the combined number. The combined numbering goes from 1 - 873.

Example:

Title
Section Number – Page X of XX (Individual section number)
X (Combined number)

The combined numbering is used as the reference location in the Table of Contents and Index.

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SECTION 00120

BIDDING REQUIREMENTS AND CONDITIONS

PART 1 GENERAL

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1.2 RELATED SECTIONS

A. Section 01455: Material Quality Requirements

1.3 REFERENCES

A. Sherman Antitrust Act

B. United States Department of Treasury Circular

C. Utah Administrative Code

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PREQUALIFY BIDDERS

A. Meet Department requirements for prequalification before submitting a proposal on all projects where the Department Engineer's advertised Estimate is greater than or equal to $1,500,000.
   1. Submit prequalification information at least 10 calendar days before submitting a proposal on projects requiring prequalification.

B. Prequalify at least once each year.
   1. The Department may change a bidder's prequalification status at any time based upon the submission of additional favorable reports or evidence of unsatisfactory performance.
   2. The prequalification amount limits bidding to individual contracts of a given size or for a particular type of work.

C. Provide experience information on the Contractor's Application for Prequalification and a confidential financial statement attested to by a certified public accountant.
   1. Include a complete report of the bidder's financial resources and liabilities, equipment, work history, and personnel. The Department establishes prequalification amount and work classification.

1.7 BIDDING DOCUMENTS

A. Prequalified bidders must acquire and submit all proposals in the identical name used on their prequalification statement, or in accordance with a filed affidavit of change in firm name or ownership.

B. Obtain bidding documents and instructions from the UDOT website. Refer to this Section, article 1.10.

1.8 JOINT VENTURE BIDDING

A. Submit a letter of intent to the Department's Prequalification Board Secretary indicating the exact name of the joint venture and the designated administrative partner before submitting a joint proposal on a single project and at least four working days before the bid opening. The Department will consolidate individual prequalification amounts for the joint venture bid.
   1. Obtain the following under the joint venture designation before bid opening:
      a. Contractor license
      b. Bid bond
      c. Bid vault certificate
      d. UDOT Contractor identification, password, and electronic signature

1.9 PROPOSAL CONTENT

A. The Department's proposal will state or include the following:
   1. Project location and description.
   2. Estimate of various item quantities and materials to be furnished.
   3. Schedule of items for unit bid pricing.
   4. Time for completing work.
   5. Proposal guaranty amount.
   6. Date, time and place of bid opening.
   7. Basis for proposal comparison, if it is other than total cost.
   8. Contract requirements not contained in the standard specifications.
   9. DBE requirements, when applicable.
   10. Date, time, and location for Mandatory Pre-bid Conference, when applicable.

B. The Department considers all documents designated in the proposal as part of the proposal.

1.10 INTERPRET PROPOSAL QUANTITIES

A. Submit unit bid prices for the estimated quantities.
   1. Quantities may increase, decrease, or be eliminated under the contract.
   2. The Department pays for actual quantities of work performed and accepted, and materials furnished under the contract.

1.11 BUY AMERICA REQUIREMENTS

A. Refer to Section 01455.

1.12 DOCUMENTS AND WORK SITE EXAMINATION

A. Carefully examine the contract documents and perform a reasonable site investigation before submitting a proposal.
   1. The bidder is responsible for all site conditions that should have been discovered had a reasonable site investigation been performed.
   2. A reasonable site investigation includes investigating the project site, borrow sites, hauling routes, and all other locations related to the performance of the work.
   3. Submitting a proposal is considered an affirmative statement that the bidder has examined the contract documents and project site, investigated the nature and location of the work, and is satisfied as to the character, quality, and general and local conditions to be encountered that can affect the work or its cost and the requirements of the proposed contract, including, but not limited to:
      a. Conditions bearing upon transportation, disposal, handling, and storage of materials.
      b. The availability of labor, water, electric power, and roads.
      c. Uncertainties of weather, river stages, irrigation channel flow, lake and reservoir levels, or similar physical conditions of the ground.
      d. The type of equipment and facilities needed preliminary to and during work performance.
      e. The character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is ascertainable from an inspection of the site, as well as from the drawings and specifications and all exploratory work made available by the Department.

B. All 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. It is understood such information was obtained and used for Department design and estimating purposes only.

C. The bidder is permitted to converse with Department personnel knowledgeable of the project, plans, specifications, materials sites, or conditions generally prevailing in the area of the proposed work to aid in pre-bid investigations.
   1. The Engineer is available by appointment.
   2. The Department is bound only by written statements, representations, or descriptions of conditions and work. No oral explanations or instructions are binding.

D. Request explanations of the written proposal documents by contacting the Engineer 14 calendar days before bid opening to allow a reply before proposal submission.
   1. The Department responds to requests to all prospective bidders by certified letter or electronic communication before the specified time for bid opening.

E. Immediately notify the Department of any apparent error, omission or ambiguity in the bid package.

F. Failure to take the actions described and acknowledged in this article does not relieve the Contractor of the responsibility for estimating the difficulty and cost of successfully performing the work, or from proceeding to successfully perform the work without additional cost to the Department.

1.13 PREPARE THE PROPOSAL

A. Obtain UDOT's current version of the Electronic Bid System (EBS) from the UDOT website. Refer to http://www.udot.utah.gov/go/standardsreferences
   1. Contact the UDOT Construction Division for Contractor ID and EBS training.

B. Prepare and electronically submit proposals using the Department's current EBS before the specified bid opening date and time.
   1. Complete all electronic bid documents specified on the Bid Submission Check List and Forms.
   2. Confirm receipt of addenda.

C. Indicate the choice in the EBS when the proposal permits a choice of alternate items. The program will not permit an additional choice.

D. Save electronic bid documents until the contract has been awarded.

E. 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

F. Bidders electronically or manually sign the Bid Report to certify they understand and are in compliance with all terms and conditions of the contract.

1.14 CERTIFY NON-COLLUSIVE BIDDING

A. Each bidder and each person signing on behalf of any bidder certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief:

1. The prices in the proposal have been arrived at independently without collusion, consultation, communication, or agreement with any other bidder or competitor for the purpose of restricting competition.
2. The prices that have been quoted in the proposal have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other 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 any other 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 any agreement, participated in any collusion, or otherwise taken any action to restrain free competitive bidding in connection with this proposal.

B. The Department will not consider a proposal for award, nor will it make any 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 if 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.

C. Any of the following does not constitute a disclosure within the meaning of this Section, article 1.11, paragraph A1:
   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.

D. A proposal made by a corporation is considered authorized by the board of directors of the bidder. Authorization is defined as signing and submitting the proposal and includes the declaration of non-collusion on the part of the corporation.

E. 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 any agreement, participating in any collusion, or otherwise taking any action unauthorized by the Utah Department of Transportation, with regard to this Contract."

F. Manually or electronically signing the Bid Proposal certifies compliance with all provisions of this Non-Collusive Bidding Certification.

1.15 PROPOSAL ACCEPTANCE

A. The Department reserves the right to disqualify a bidder as non-responsive or refuse a proposal for any of the following reasons:
   1. Proposal does not acknowledge receipt of addenda.
   2. Award of additional work could impede or prevent timely completion of work currently under contract.
   3. Failure to pay or settle all outstanding labor and material bills or claims for a contract current at the time the proposal is issued.

4. More than one proposal for the same work is submitted from an individual, firm, or corporation under the same or different names.
5. Default under previous contracts.
6. Unsatisfactory performance on previous or current contracts
7. Debarment by the Department, any State, or the Federal Government.
8. Serious misconduct that adversely affects the ability to perform future work.
9. Failure to reimburse the Department for monies owed on any previously awarded contract, including any contract where the prospective bidder was a party to a joint venture that failed to reimburse the Department.
10. Bid Guaranty received after date and time specified.
11. Non-attendance of a mandatory pre-bid meeting.
12. Proposal received after date and time for bid opening.
13. Manually submitted delivered diskette is blank or unreadable.
14. Proposal not submitted using UDOT's current EBS program.

B. The bidder may appeal in writing to the UDOT Deputy Director pursuant to administrative rules regarding administrative procedures and appeals as set forth in Utah Administrative Code R907-1, as amended if the Department refuses to accept a proposal for any of the foregoing reasons.

1.16 IRREGULAR PROPOSALS

A. The Department considers a proposal irregular and rejects the proposal as non-responsive if:
1. Not properly signed.
2. The Contractor is not prequalified or there is an insufficient amount of prequalification or unauthorized work classification.
3. Unauthorized additions, conditional or alternate bids, or other irregularities make 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 letting. The Department selects which contracts to award.
5. It lacks required bid documentation escrow, when applicable.
6. Noncompliant with any prequalification regulations.
7. It fails to furnish a properly executed proposal guaranty in accordance with this section.
8. There is evidence of collusion among bidders.
9 The proposal does not comply with conditions of current special provision for certification of Affirmative Action (DBE).

10. It omits a unit price for any estimated pay item, except for authorized alternate bid items.
11. It is materially unbalanced.
12. The proposal does not have a Status of Work Under Contract if required, reflecting the Contractor's current prequalification status or:
    a. Is incomplete and improperly executed.
    b. The sum of the amount of all uncompleted work plus the estimate of the amount of work bid exceeds the amount for which the Contractor is prequalified.
13. The proposal fails to meet any other material requirement of the invitation for bids.

1.17 PROPOSAL GUARANTY

A. Provide a proposal guaranty in the form an electronic guaranty bond, or provide evidence of securing a cashier's or certified check, for not less than 5 percent of the total amount of the bid 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 UDOT approved surety clearing house for electronic guaranty bond.
    2. Use current version of the UDOT EBS program.
    3. Apparent low bidder delivers proposal guaranty in the form of cashier's or certified check within three calendar days of bid opening.

1.18 PROPOSAL DELIVERY

A. Electronically transmit the proposal before the time specified in the Notice to Contractors.

B. A manually delivered proposal takes precedence over an electronically delivered proposal.

1.19 WITHDRAWAL OR REVISING PROPOSALS

A. A proposal may be withdrawn or revised before the time set for receiving proposals.

B. Provide the request for withdrawal to the Department with a telephone call followed by documented electronic communications including a company authorized signature and the UDOT Contractor ID before the time set for receiving proposals.

1.20 COMBINATION OR CONDITIONAL PROPOSALS

A. Proposals may be issued for projects in combination or separately.
   1. Proposals may be submitted either on the combination or on separate units of the combination.
   2. The award of combination proposals or separate proposals is made to the advantage of the Department.
   3. The Department will consider only proposal combinations that it specifies.
   4. The Department writes separate contracts for each individual project included in the combination.

B. The Department considers conditional proposals only when specified in the advertisement.

1.21 PUBLIC OPENING OF PROPOSALS

A. Proposals will be downloaded from the third party repository and publicly opened at the time indicated in the invitation for bids.

1.22 DEBARMENT

A. The Department may debar a Contractor from performing any work on Department or Department administered projects if:
   1. The Contractor or an affiliate (defined as an owner, director, manager, officer or fiscal agent of the Contractor) has been convicted of or entered a plea of guilty or *nolo contendere* to a bid-related or a contract-related crime in any Court of competent jurisdiction.
   2. The Contractor or an affiliate has made a public admission of any bid-related or contract-related crime.
   3. The Contractor or an affiliate has falsified information or submitted deceptive or fraudulent statements in connection with prequalification, bidding, or performance of a contract.
   4. The Contractor or an affiliate has violated relevant antitrust laws covering bid rigging, collusion or restraint of free competition among contractors; (Violations covered by the Sherman Antitrust Act, 15 U.S.C. 1, *et seq.* and Title 76, Chapter 10, Section 911, *et se.,* U.C.A. 1953, as amended).
   5. The Contractor or an affiliate has demonstrated willful wrongdoing reflecting a lack of integrity in bidding or performing public projects.

6. The Contractor, joint venturer, stockholder of 5 percent or more of the contract, an affiliate, or any immediate relatives of the aforementioned, has been debarred or affiliated with another debarred person or contractors by the Federal Government or by another State government.
7. The UDOT Deputy Director has reasonable grounds to believe and finds that the Contractor has acted in collusion with others to perform work on a project that supposedly satisfies disadvantaged business enterprise goals or requirements through other than *bona fide* disadvantaged business entities in any combination of individuals, firms or corporations.
8. The Contractor or affiliate has defaulted under previous contracts.
9. The Contractor or affiliate has unsatisfactory performance on previous work or current contract(s) consisting of, but not limited to:
    a. Noncompliance with contract.
    b. Failure to complete work on time.
    c. Instances of substantial corrective work before acceptance.
    d. Instances of completed work that requires acceptance at reduced pay.
    e. Production of non-specification work or materials, and when applicable, required price reductions or corrective work.
    f. Failure to provide adequate safety measures and appropriate traffic control that endangered the safety of the workforce and public.
10. The Contractor or an affiliate has questionable moral integrity as determined by the Department, the Attorney General of Utah or the Attorney General of the United States.
11. Failure to reimburse the State for monies owed on any previously awarded contract including those where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the State for monies owed.
12. The UDOT Deputy Director has reasonable grounds to believe and finds that the public health, welfare or safety imperatively requires such action.

1.23 STATUS PENDING DEBARMENT

A. The Contractor notified of proposed debarment as provided above is not permitted to contract with the Department nor act as a subcontractor unless a request for either an informational or formal hearing is pending.
    1. The Deputy Director may suspend the Contractor from consideration for award of contracts if the Department's Deputy Director believes there is probable cause that a Contractor has engaged in activity that will lead to debarment under Utah Administrative Code R907-67-1.

a. A contractor who is suspended may not submit a bid on any Department proposals, nor act as a subcontractor for the duration of suspension.
b. The duration of the suspension is for the greater of:
   1) Three months
   2) The duration of the Contractor's appeal

B. The proposed debarment period does not begin until the Department decision has been issued following the said hearing or hearings.

1.24 DEBARMENT LENGTH

A. Debarment is for a term of not less than six months and up to three years as determined by the Deputy Director.

B. The Department may adjust the period of debarment for mitigating circumstances including but not limited to the following:
   1. Degree of culpability.
   2. Restitution of damages to the State.
   3. Cooperation in the investigation of other bidding crimes.
   4. Disassociation with those involved in bidding crimes.
   5. Protection of the State that may be required.
   6. If such action would have unintended adverse consequences on competition.

C. Debarment in no way affects the obligation of a Contractor to the Department to perform under existing contracts.

D. The Department also reserves the right to declare a debarred Contractor in default on any existing contracts for adequate cause as provided in such contracts.

1.25 DEBARMENT PROCEDURES

A. The procedure described in this Section, article Debarment applies if it is found that a Contractor or an affiliate thereof is violating the prohibited activities.

B. The Director for Construction and Materials notifies the Contractor in writing and by certified mail of the Department's intention to debar. Written notice specifies:
   1. The grounds for such intended debarment.
   2. The date debarment becomes effective and the intended period of debarment.

3. The procedure to follow if the Contractor desires to challenge the debarment or to offer information to the Department in mitigation of its alleged actions.

C. The Contractor may request within 15 calendar days of receiving the notice of intended debarment either:
   1. An investigative hearing before the Director for Construction and Materials.
   2. An informal administrative hearing before the UDOT Deputy Director.

D. The Contractor who elects to proceed at an investigative hearing has the opportunity to appear at a mutually agreed upon time and location.
   1. The Contractor may supply information in support of their position and has the opportunity to review the Department's evidence, present evidence, and discuss matters informally.
   2. No legal counsel is permitted for either party at the informal hearing.

E. The UDOT Deputy Director of Transportation or designee conducts the informal administrative hearing with assistance from Department staff as required. The Contractor who appears may be represented by counsel and has the opportunity to review the Department's evidence, and to present evidence in rebuttal either by sworn affidavit or by sworn testimony.

F. The Department representative conducting the hearing issues a written decision no later than 30 calendar days following either hearing.

G. The Contractor files notice in writing with the UDOT Deputy Director within 20 calendar days after receiving the decision from the Director for Construction and Materials if the decision is to be appealed. The Deputy Director then schedules a formal hearing as specified above.

H. The decision of the UDOT Deputy Director is administratively final following an informal hearing and specifies the facts justifying the Department’s actions and conclusion.

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 Not Used

1.2 RELATED SECTIONS

A. Section 00570: Definitions

1.3 REFERENCES

A. United States Department of Treasury Circular

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PROPOSAL CONSIDERATION

A. The Department publicly opens properly executed proposals using the current version of the EBS to compare bids 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.

B. The Department reserves the right to reject any or all proposals, waive technicalities, or advertise for new proposals.

C. The bidder can request withdrawal of a bid after bid opening by:
   1. Submitting to the Director for Construction and Materials a notarized affidavit within 24 hours after bid opening declaring a clerical or mathematical error in bid preparation.
   2. Submitting accompanying declaration with original work sheets used in bid preparation.
   3. Describing specific errors in detail.
   4. Verifying that error has a significant monetary effect in the amount of 3 percent of the bid or greater.

D. The bidder may not request bid withdrawal for judgmental errors.

1.7 CONTRACT AWARD

A. The Department awards the contract to the lowest 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 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 reserves the right to cancel the award of any contract before execution without liability.

1.9 RETURNING PROPOSAL GUARANTY

A. Proposal guaranties are returned after satisfactory contract bonds and all insurances have been furnished and the contract has been executed.

B. A bidder is not released from the bidding obligation because of an alleged error in the preparation of the proposal unless the Department returns the proposal guaranty.

1.10 CONTRACT BONDS

A. The Department furnishes required contract bond forms.

B. Return executed forms to the Department as required by the Utah Procurement Code.
   1. **Payment Bond** secures the payment of the claims of laborers, mechanics or materialmen employed on the work under the contract.
   2. **Performance Bond** guarantees the faithful performance of the contract.

C. Each bond must equal 100 percent of the contract price.

D. Underwriting Limitation is stated in the United States Department of Treasury Circular 570; Surety Companies Acceptable on Federal Bonds. Only companies listed in the Department of Treasury Circular 570 are acceptable.

E. The Department may make alterations, extensions of time, extra and additional work, and other changes authorized by the contract without securing the consent of the surety or sureties on the contract bonds.

F. The Department cancels all work on the contract, unless the Department determines it is in the public interest to continue the work if a Contractor's surety is unable to provide payment.

G. As an alternate contract bond, furnish a cash bond of two cashier's checks, each in the amount of Contractor's bid amount.
   1. The Department holds the cash bond and uses it when needed for correction of any non-performance or non-payment.
   2. The Department returns to the Contractor one half of the cash bond minus any cost against the bond upon release by the Engineer for satisfactory completion of the work.
   3. The Department releases the remaining cash bond if no payment claims have arisen within 90 calendar days after release by the Engineer.
   4. The Department holds the cash bond until the non-performance and non-payment issues are resolved. Contractor accrues no liability during this time.
   5. The Department decides the need for withholding the cash bond.

1.11 EXECUTING AND APPROVING THE CONTRACT

A. Return the signed contract, properly executed contract bonds, and all required insurances to the Department within 15 calendar days after 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 signed contracts and bonds and insurances.
   2. The contract is not considered in effect until executed by all parties.

1.12 MATERIALS GUARANTY

A. The successful bidder must:
   1. Furnish a complete statement of the origin, composition, and manufacturer of material proposed for use in the construction.
   2. Furnish samples to be tested and inspected for meeting the contract.

B. 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, and the time limit of the guaranty.
   2. Sign and deliver the guaranty to the Engineer before acceptance of the contract in accordance with Section 00570.
   3. Upon completion of the contract, the required performance bond may be reduced 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 1.7.

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 evidencing coverage within 15 calendar days after the date of the Notice of Award.

B. The Department may then award the contract to the next lowest responsible bidder, or may re-advertise the work.

1.14 BID DOCUMENTATION ESCROW

A. Submit with the proposal a legible copy of the bid documentation as defined in Section 00570 if specified. Meet the following:
   1. Submitting and Returning Bid Documentation
      a. Submit bid documentation in a sealed container early marked “Bid Document” and labeled with the bidder’s name and address, submission date, and project number.
      b. Bid documentation is returned to all but the successful bidder after the contract has been executed.
   2. Affidavit
      a. In addition to bid documentation, submit a signed and certified affidavit that lists each bid document submitted by author, date, nature and subject. The affidavit must attest that:
         1) The affiant has examined the bid documentation and that the affidavit lists all documents used to prepare the bid.
         2) The sealed container contains all such bid documentation

3. Duration and Use
   a. After executing the contract, the Department and the Contractor must jointly deliver the sealed container and affidavit to a bank or other Department-designated bonded document depository for safekeeping in a safety deposit box, vault, or other secure accommodation.
   b. The document storage agreement must indicate that the bid documentation and affidavit will remain in escrow during the life of the contract or until the Contractor notifies the Department of its intent to file a claim or initiate contract-related litigation against the Department. Such action is sufficient ground for the Department to obtain the release and custody of the escrowed bid documentation.
   c. Absent a claim or notice of the Contractor's intent to file a claim, the Department will direct the depository to release the sealed container to the Contractor provided the Contractor signs the final standard release form.
   d. Certifying that the materials in escrow represent all documentation used to prepare the bid waives the Contractor's rights to use bid documentation other than those in escrow, should contract disputes arise.
4. Refusal or Failure to Provide Bid Documentation
   a. Failure to provide bid documentation renders the bid nonresponsive.
5. Confidentiality
   a. Materials held in escrow remain the property of the Contractor unless the Department receives the Contractor's notification of intent to file a claim or litigation ensues. If either occurs, the materials become the property of the Department until the claim is resolved or litigation is concluded.
   b. Originals and copies of escrow materials will be returned to the Contractor once litigation is concluded, outstanding claims are resolved, or final release is executed.
   c. The Department will make every reasonable effort to ensure the confidentiality of bid documentation to the extent allowed by the Governmental Records Access and Management Act, Title 63, Title 2, Utah Code Annotated.
6. Cost and Escrow Instruction
   a. The Department will pay to store all escrowed materials and will provide escrow instructions to the depository.
7. Payment
   a. Include within the overall contract bid price all costs to comply with this article.

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 Not Used

1.2 RELATED SECTIONS

A. Section 00570: Definitions

B. Section 00725: Scope of Work

C. Section 00727: Control of Work

D. Section 01282: Payment

E. Section 01355: Environmental Protection

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PRECONSTRUCTION CONFERENCE

A. Contact Engineer within 14 calendar days of receiving Notice of Award to schedule preconstruction conference.

1.7 NOTICE TO PROCEED

A. Proceed with the work after receipt of written notice from the Department.

B. Notify the Engineer at least five calendar days before beginning work.

1.8 CONTRACT SUBLETTING

A. Obtain written approval of the Engineer before subletting, selling, transferring, assigning, or disposing any portion of the contract.

B. Sublet no more than 70 percent of the total contract bid amount.

C. Subcontracts, whether committed to in writing or by an informal, unwritten arrangement or transfer of the contract, or any part of it or its obligations, do not relieve liability under the contract and bonds. As part of its contract with the Department, the Contractor accepts liability for any claims for damages or liability resulting from an act or omission of any person who carried out work on its behalf, whether that working relationship is through a subcontract or carried out by an informal, unwritten agreement. The Contractor agrees to indemnify the Department for any damages or liability, including attorney's fees and court costs, which may be incurred by such a person.

D. Do not allow subcontracted work to begin until the request to sublet work is approved by Engineer.

E. The Department considers an item as subcontracted in its entirety unless otherwise designated in the subcontract In computing the percentage of subcontracted work.
   1. The Department uses the accumulated percentages of all approved subcontracts to determine that the maximum subcontracted limitation is not exceeded.
   2. The Department uses the total dollar amount of the items subcontracted in the contract bid proposal, divided by the original contract amount to determine the amount of work subcontracted.
   3. The Department determines the amount of work allowed to be subcontracted by using the dollar amount of the item agreed to between the prime Contractor and the subcontractor, excluding bonds, insurance, profit, and office transaction, etc.

F. For all subcontracts:
   1. Provide for a reduction in retained money equal to the percentage retained in accordance with Section 01282.
   2. Include a statement describing the method of distribution of any adjustment due to price increases or decreases using applicable price adjustment specifications for fuel, asphalt, cement, common carrier rates, etc.

1.9 ANTICIPATED MONTHLY PAYMENT SCHEDULE

A. Prepare the Anticipated Monthly Payment Schedule based on the proposed sequence of activities shown in the baseline construction schedule.
   1. Use the form provided by the Engineer.
   2. Submit the schedule before the date established for the first partial payment.
   3. Include both monthly and semi-monthly payments when expected due to the volume of work on the project.

4. Include all contract months when payments are anticipated.
5. Include dates of contract start, suspension, completion and milestones that impact payments.

B. Submit a revised Anticipated Monthly Payment Schedule within 30 calendar days after notification by the Engineer. Revisions are required when:
1. Payments vary more than10 percent from the submitted schedule and the variance is sustained for 60 calendar days.
2. Contract start, suspension, completion and milestones dates change.
3. Change orders are approved increasing or reducing the contract amount sufficient to vary actual payments more than 10 percent from the accepted schedule.

1.10 BASELINE CONSTRUCTION SCHEDULE

A. Provide the Engineer with a baseline construction schedule meeting the requirements of this section using Primavera 5.0 or current version or Primavera Contractor.
1. Accurately reflect the proposed approach to accomplish the work.
2. Provide a schedule narrative as described in this article.

B. Use the baseline construction schedule to coordinate all activities on the project, including those with other entities such as subcontractors, vendors and suppliers, utilities, local governments, special service districts, and the Department.

C. Employ a sufficient workforce, supply adequate materials and equipment, and progress the work with such diligence as to maintain the rate indicated in the accepted baseline construction schedule.
1. All costs to maintain the schedule are solely the Contractor's obligation and at no expense to the Department.

D. Schedule Submission
1. Submit to the Engineer a baseline construction schedule with schedule narrative within 14 calendar days of the Notice of Award. Submit one hard copy and one electronic copy in a format acceptable to the Engineer.
2. The Engineer reviews the schedule and returns it, accepted or with comments, within seven calendar days from the date of receipt.
   a. Address any comments and revise the schedule as necessary to the satisfaction of the Engineer.

3. Complete the final baseline schedule and obtain Engineer's acceptance within 30 calendar days from the Notice of Award.
   a. No progress payments are made before the Engineer accepts the baseline construction schedule.
4. The Contractor is solely responsible for planning and executing the work. Engineer's acceptance of the baseline schedule does not:
   a. Imply approval of any particular construction methods or relieve the Contractor's responsibility to provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the contract,
   b. Attest to the validity of assumptions, activities, relationships, sequences, resource allocations, or any other aspect of the baseline construction schedule.
5. Failure to include any element of work required by the contract in the accepted baseline construction schedule does not relieve the Contractor's responsibility to perform such work.
6. The baseline construction schedule does not modify the contract documents.

E. Schedule Requirements

Address the following with as much detail required:

1. Define a complete and logical plan that can realistically be accomplished for executing the work defined in the contract.
2. Include sufficient activities for adequate project planning for subcontractor, third party, vendor, and supplier activities.
3. Clearly show the critical path using the longest path definition and other critical elements of work.
   a. Define the critical path of the schedule based on resource limitations if the schedule is resource loaded and leveled.
4. The Engineer defines the additional Department costs required to support an accelerated schedule for early completion such as increased staff for inspection, testing, overtime, etc.
   a. Pay for these added costs unless waived by the Engineer on the basis of other benefits accrued to the Department.
5. Clearly 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 day before the Notice to Proceed.
7. Include a unique identification number for each schedule activity.
8. Clearly and uniquely define each activity description. Do not use descriptions referring to a percent complete of a multi-element task such as "construction 50 percent of deck".
9. Define the duration of each activity.
   a. Limit the maximum duration of any activity to 15 days unless otherwise accepted by the Engineer.
10. Clearly identify the relationships tying activities together.

11. Do not have any open-ended activities except for one start and one finish activity.
12. Do not have any constrained activities unless the Engineer accepts such constraints.
13. Do not sequester project total float through manipulating the calendars, extending activities durations, or any other such methodology.
14. Use resource loading if resource limitations can 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.
15. Include milestones to define significant contractual events such as Notice to Proceed, substantial completion, and coordination points with outside entities such as utilities, special service districts, etc.
16. Include a well-defined activity coding structure that allows project activities to be sorted by type of work, location of work, work breakdown structure (WBS), or as mutually agreed to by the Contractor and the Engineer.
17. Clearly define calendars.

F. Schedule Narrative Requirements
1. Provide a schedule narrative that describes:
    a. The construction philosophy supporting the approach to the work outlined in the baseline schedule. Address the reasons for the sequencing of work and describe any limited resources, potential conflicts, and other salient items that may affect the schedule and how they may be resolved.
    b. The justification for activities with durations exceeding 15 working days.
    c. The justification for constraints used.
    d. The justification for unusual calendars used.
    e. The approach used to apply relationships between activities for example, all ties are based on physical relationships between work activities - rebar must be placed before concrete is placed or relationships are used to show limited resources - bridge two follows bridge one because the Contractor only has one bridge crew etc.
    f. The project critical path and challenges that may arise associated with the critical path.
    g. How the coordination with other entities will be handled.

G. Project Float

Total project float is defined as the cumulative length of time activities can be delayed before they affect the finish date of the project or a contractual milestone.

1. Float is a shared commodity between the Contractor and the Department and not for the exclusive use or financial benefit of either party.
    a. Either party has the full use of the project float until it is depleted.

1.11 CONSTRUCTION SCHEDULE UPDATES

A. Update the construction schedule each month during the life of the contract until the closing date for the scheduled progress payment following project final acceptance.
1. The Engineer does not approve progress payment until an acceptable schedule update has been received.
2. Show actual progress for each activity:
    a. Actual start and finish dates for completed activities
    b. Actual start dates, percent complete, and remaining duration for activities in progress
    c. Projected sequences of activities for future work
    d. Revised relationships and durations for unfinished activities, if warranted
    e. A well-defined critical path
    f. Change the data date to one day after the closing date for the monthly progress payment

B. Submit one hard copy and one electronic copy of the schedule update to the Engineer for review and acceptance.

C. Along with the updated schedule, submit a narrative describing:
1. Work performed during the estimate period.
2. Problems or delays that have been experienced to date, the party responsible for the problems or delays, and the Contractor's plan to resolve the problems or bring the delayed activities back on schedule.
3. Differences between the work performed and the work planned for the period, including explanations for the deviations.
4. The current critical path of the project, explaining any changes since the last update and the impacts of these changes.
5. Reasons for and impacts resulting from all of the following that apply:
    a. Added or deleted activities
    b. Changes in activity durations
    c. Changes in relationships between activities

d. Addition or deletion of constraints
e. Changes to project calendars

6. The work to be accomplished during the next period. Provide reasons for deviations from the previous schedule update.
7. Potential problems that may be encountered during the next period and the proposed solutions. Identify all potential problems the Department may be party to and explain what action the Department needs to take and the date by which time the action needs to be taken to avoid the problem.

D. Participate in a progress meeting at the request of the Engineer, to review and discuss the updated schedule information including any activity delays, remedies, schedule revisions, coordination requirements, change orders, potential delays, and other relevant issues.
1. Make available the project manager, scheduler, and appropriate field personnel to participate in the progress meeting.
2. Make and record 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.
3. Submit a revised schedule update if necessary.

1.12 LIMITATION OF OPERATIONS

A. Minimize interference with traffic during performance of the work.

B. Do not perform any work without written approval except for repairing or servicing equipment, protecting work, maintaining or curing concrete, and maintaining traffic on Sundays or holidays.

C. Night work:
1. Provide five calendar day's notice before starting night work.
2. Provide adequate lighting for performing satisfactory inspection and construction operations.
3. Control noise and vibration in accordance with Section 01355.

1.13 CHARACTER OF WORKERS

A. Provide sufficient resources to complete all work in accordance with the contract and 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 intemperate or disorderly. Return these employees to the project only with the Engineer's written permission.

C. The Engineer may suspend work for the Contractor's failure to remove any employee or furnish suitable and sufficient personnel to perform the work.

1.14 METHODS AND EQUIPMENT

A. Use equipment of the size and mechanical condition to perform and produce the specified work.

B. Do not damage the roadway, adjacent property, or other highways.

C. Use methods or equipment other than specified in the contract only with the Engineer's written permission.
   1. Describe in writing the proposed methods, equipment, and reasons for the change.
   2. Produce work that meets project requirements.
   3. Discontinue alternate methods or equipment if the Engineer determines that the work does not meet contract requirements.
   4. Remove and replace or repair deficient work to meet specified quality at no cost to the Department.
   5. The Department does not change the basis of payment or contract time for a change in methods or equipment.

1.15 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 allowed to complete the contract. Contract time is measured in either working days or calendar days as defined in Section 00570. The completion date is when the contract specifies the work is required to be substantially complete.
   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 when the contract defines the time allowed to complete the contract in working days or calendar days.

C. The Engineer furnishes a Monthly Status of Contract Time 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 written protest documenting the differences is submitted to the Engineer within seven calendar days of receipt.

2. File a written protest with the Engineer within seven calendar days of receiving Monthly Status of Contract Time charges on working day contracts when not in agreement with the time assessed.
   a. Document asserted discrepancies in the time assessed.
   b. Failure to file a protest is acceptance of the time assessments.

D. Refer to Section 00570 for definitions of substantial completion, physical completion, and contract completion.

1.16 DETERMINING COMPENSATION AND CONTRACT TIME EXTENSION FOR EXCUSABLE DELAYS

A. Request a contract time extension for excusable delays in accordance with this article. Refer to Section 00570.
   1. Time may be granted for non-compensable delays that impact the project schedule's critical path. Additional compensation will not be granted.
   2. Time and monetary compensation may be granted for compensable delays that impact the project schedule's critical path and the Contractor's costs.

B. Provide a written request to the Engineer within seven calendar days of the occurrence of an excusable delay detailing the reasons for a time extension and additional compensation, if applicable. The Engineer responds to the written request as described for differing site conditions, changes, and requests or claims for additional compensation as specified in Section 00725.
   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. Costs incurred before notification of delay are not allowed.
   3. Provide the Engineer with a schedule impact analysis showing the impact of the delay-causing event on the project schedule.
   4. Maintain daily records of all labor and material costs, station locations, and equipment expenses for all operations affected.
      a. Obtain Engineer's concurrence with these records on a daily basis.
   5. Prepare and submit weekly written reports to the Engineer that contain:
      a. Number of delay days.
      b. Summary of all delayed operations or those 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) Summarize equipment time charges and identify equipment by manufacturer's number.
4) Provide certification of all costs.

6. Meet with the Engineer weekly to compare the previous week's daily records with those maintained by the Department.
   a. Resolve any disagreement over weekly delay costs with the Engineer.
   b. Provide written notice within 10 calendar days documenting the disagreement between Department and Contractor calculations of weekly delay costs.
   c. Failure to provide written notification is interpreted as acceptance that Department records are accurate.

C. Contract adjustment is made as written modification to the contract through change order, when warranted, unless the Contractor does not notify the Engineer in accordance with this article.
   1. Time will be added to the contract based on the overall extension of the critical path of the project schedule attributed to the delay-causing event.

D. Delay compensation for excusable delays is made in accordance with Section 01282.

E. The Contractor may pursue a claim for additional compensation or contract adjustment as specified in Section 00727 if the Engineer decides a contract adjustment identified by the Contractor is unnecessary and the Contractor does not agree with the Engineer's decision.

1.17 FAILURE TO COMPLETE ON TIME

A. Achieve substantial completion within the specified contract time. The Department deducts the sum specified in Table 1 from any money due for each calendar day or working day that any work remains necessary for substantial completion after the specified contract time including any approved extensions.

B. Achieve physical completion no later than 30 calendar days after substantial completion. The Department deducts $210 per day from any money due for each calendar day beyond 30 calendar days following substantial completion for any work necessary for physical completion. Refer to Sections 00570 and 00727.

C. Achieve contract completion no later than 30 calendar days after notification of physical completion or final acceptance. The Department deducts $100 per day from any money due for each calendar day beyond 30 calendar days following notification of final acceptance that any Contractor obligation under the contract remains unfulfilled. Refer to Sections 00570 and 00727.

Table 1

Schedule of Liquidated Damages			
Original Contract Amount		**Daily Charge**	
From More Than	**To and Including**	**Calendar Day Completion Date**	**Work Day**
$0	$100,000	$210	$830
100,000	500,000	450	950
500,000	1,000,000	680	1,380
1,000,000	5,000,000	1,270	2,170
5,000,000	10,000,000	1,860	2,950
10,000,000	30,000,000	2,770	4,930
30,000,000		4,100	8,240

D. Continuing and completing the work after the contract time expires does not waive the Department's rights under the contract.

1.18 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 assure the prompt completion of the work.
3. Does not meet contract work requirements or neglects or refuses to remove and replace rejected materials or unacceptable work.
4. Stops work.
5. Does not resume stopped work within the time specified upon notification from the Department.
6. Becomes insolvent or 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. Does not comply with contract requirements including minimum wage payments or EEO contract requirements.
10. Is a party to fraud.

B. The Engineer 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 expense 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 or that the delay was excusable.

1.19 CONTRACT TERMINATION FOR PUBLIC CONVENIENCE

A. The Department may by written order 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.
   1. Specifics on the termination and the effective date will be detailed in a Notice of Termination.

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. 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. Place no 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. Unfabricated or partially fabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated,
      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 all completed items of work as of that date at the contract bid price when the Department orders termination of a contract effective on a certain date.
   1. The Department pays for partially completed work either at agreed prices or by force account methods.
   2. The Department pays for items that are eliminated in their entirety in accordance with Section 01282.

E. Materials obtained by the Contractor that have not been incorporated into the project may be:
   1. Purchased from the Contractor at the option of the Department at actual cost delivered to a prescribed location.
   2. Disposed of as mutually agreed.

F. Contractor may submit a claim for additional costs not covered in the contract after receipt of Notice of Termination from the Department.
   1. Submit within 60 calendar days of the effective termination date.
   2. Include cost items such as:
      a. Reasonable idle equipment time
      b. Mobilization efforts
      c. Bidding and project investigative costs
      d. Overhead expenses attributable to the project terminated
      e. Reasonable profit on work completed

f. Subcontractor costs not otherwise paid for
g. Actual idle labor cost if work is stopped before termination date
h. Guaranteed payments for private land usage as part of original contract
i. Any other direct cost the Contractor has incurred

3. The negotiated settlement figure reached with the Contractor does not include loss of anticipated profits.

G. Make cost records available to the Department for determining the validity and amount of each item claimed and for providing a basis for negotiating an equitable settlement.

H. 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 Not Used

1.2 RELATED SECTIONS

A. Section 00725: Scope of Work

B. Section 01280: Payment

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.	AAN	American Association of Nurserymen
2.	AAR	Association of American Railroads
3.	AASHTO	American Association of State Highway and Transportation Officials
4.	ACI	American Concrete Institute
5.	AGC	Associated General Contractors
6.	AI	Asphalt Institute
7.	AIA	American Institute of Architects
8.	AISC	American Institute of Steel Construction
9.	AISI	American Iron and Steel Institute
10.	AMRL	AASHTO Materials Reference Laboratory
11.	ANLA	American Nursery and Landscape Association
12.	ANSI	American National Standards Institute
13.	API	American Petroleum Institute
14.	APL	Accepted Products Listing
15.	ARA	American Railway Association
16.	AREA	American Railway Engineering Association
17.	AREMA	American Railway Engineering and Maintenance-of-Way 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.	AAWS	American Welding Society
26.	CCTV	Closed Circuit Television
27.	CFR	Code of Federal Regulations
28.	CSI	Construction Specification Institute
29.	DMS	Dynamic Message Sign
30.	EBS	UDOT's Electronic Bid System
31.	ESS	Environmental Sensor Sign
32.	EUSERC	Electric Utility Service Equipment Requirements Committee
33.	FHWA	Federal Highway Administration
34.	FSS	Federal Specifications and Standards
35.	GRC	Galvanized Rigid Conduit
36.	GSA	General Services Administration
37.	HAR	Highway Advisory Radio
38.	ID	Identification
39.	IMSA	International Municipal Signal Association
40.	ISO	International Organization for Standardization
41.	ITE	Institute of Traffic Engineers
42.	ITS	Intelligent Transportation System
43.	MIL	Military Specifications
44.	MMF	Multi-Mode Fiber
45.	MUTCD	Manual on Uniform Traffic Control Devices
46.	NEC	National Electric Code
47.	NEMA	National Electrical Manufacturers Association
48.	NVLAP	National Verification Laboratory Acceptance Program (Bureau of Standards)
49.	OSHA	Occupational Safety and Health Administration
50.	OTDR	Optical Time Domain Reflectometer
51.	PCA	Portland Cement Association
52.	PDPL	Performance Data Products Listing
53.	PTI	Post-Tensioning Institute
54.	RMS	Ramp Metering Station
55.	RWIS	Roadway Weather Information System
56.	SAE	Society of Automotive Engineers
57.	SMF	Single-Mode Fiber
58.	SSPC	The Society for Protective Coatings
59.	SWPPP	Storm Water Pollution Prevention Plan
60.	TMS	Traffic Monitoring Station
61.	TOC	Traffic Operations Center
62.	UDOT	Utah Department of Transportation

63. UL Underwriters Laboratory
64. UPDES Utah Pollution Discharge Elimination System
65. USAS United States of American Standard Institute
66. USC United States Code
67. VIDS Video Image Detection System
68. VMS Variable Message Sign
69. WIM Weigh in Motion
70. 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. Excludes profit.
3. **Addendum:** Contract revision developed between advertising and opening bids.
4. **Advertisement:** The public announcement requesting bids for specified work or materials.
5. **Award:** The Department's acceptance of a bid or proposal.
6. **Backfill:** Material used to replace, or the act of replacing material removed during construction.
7. **Bid:** Bid proposal. A bidder's written offer or proposal on Department furnished forms to perform stated work at the quoted prices.
8. **Bid Documentation:** All writings, working papers, computer printouts, charts, and data compilations containing or reflecting a bidder's information, data, or calculations used to determine the bid proposal. Bid documentation includes material used to decide and apply:

   Equipment rates
   Overhead rates
   Labor rates
   Efficiency or productivity factors
   Arithmetic extensions
   Subcontractor and material supplier quotations

   Reference all manuals used to determine the bid proposal, including name, date, and publisher. Bid documentation excludes any Department documents provided to the bidder used to prepare the bid proposal.

9. **Bid Documentation Escrow:** Preserving successful bid documentation to be used in the event of a claim or litigation between the bidder and the Department.
10. **Bidder:** An individual or legal entity submitting a bid or response to a Department request for proposals.
11. **Bid Guaranty:** The security furnished with a bid to assure that the bidder will enter into the contract if the bid is accepted.
12. **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 undercopings of abutments or extreme ends of openings for multiple boxes.
13. **Bridge Length:** The over-all length of a bridge measured along the line of survey stationing back to back of the backwalls of abutments, if present, otherwise end to end of the bridge floor. In no case is the bridge length less than the total clear opening of the structure.
    a. **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 in accordance with and meets the applicable specifications.
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 specified tests.
18. **Change Order:** A written order to the Contractor detailing changes to the specified work quantities, extra work, or modification to the original contract which establishes the basis of payment and time adjustments for the affected changes.

19. **Claims Review Board:** A board established by UDOT policy to hear and review Contractor claims not settled or resolved at the Department's District or Region level. The board makes recommendations to the Department's Deputy Director for settlement.
20. **Commercial Materials Source:** A commercial materials source site or materials plant that sells to the general public before the Department's advertisement of the contract, whose continuance in operation is determined wholly without regard to a particular Federal or Federally assisted contract, and possesses the required retail sales tax license and business license in its residential State.
21. **Commission:** The Utah Transportation Commission.
22. **Completion Date:** The date when the contract work is specified to be substantially complete.
23. **Concrete - Small Structure:** Eight cubic yards or less of concrete.
24. **Conformity:** Conformance. Compliance with reasonable and customary manufacturing and construction tolerances where working tolerances are not specified. Where working tolerances are specified, conformity means compliance with such tolerances.
25. **Construction Limits:** Area of established boundaries within the highway right-of-way or construction easements that defines the construction area.
26. **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. Invitation for bids
    b. Bid proposal
    c. Contract bond
    d. Specifications
    e. Special provisions
    f. General and detailed plans
    g. Notice of award
    h. Notice to proceed
    i. Authorized contract time extensions
    j. Any change orders and agreements required to complete the work in an acceptable manner
27. **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, but not including Time.
28. **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 bid item.
29. **Contract Bonds:** The approved form of security, executed by the Contractor and the Contractor's surety or sureties, guaranteeing

complete execution of the contract, including change orders, 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 guarantee 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 guarantee completion of the work under the contract.

30. **Contract Completion:** The day, determined by the Engineer, when all work specified in the contract is completed and all obligations of the Contractor under the contract are fulfilled. Furnish all documentation required by the contract and required by law before this date.

31. **Contract Pay Item:** A specific unit of work for which a price is provided in the contract and paid, subject to contract provisions, to the Contractor for the accepted quantities. Exceptions include, but are not limited to, the items Time, and Lane Rental, which are not pay items. No payment will be made for the bid items titled Time and Lane Rental.

32. **Contract Time:** The date, or number of working days or calendar days allowed for substantial completion of the contract, including authorized time extensions. When a completion date is specified, reach substantial completion on or before that date, even when that date is a Saturday, Sunday or holiday.

33. **Contractor:** The individual or legal entity contracting with the Department for performance of prescribed work.

34. **Contractor Affiliate:** Any person associated with the Contractor in the capacity of owner, partner, director, officer, principal investigator, project director, manager, auditor, or other like position.

35. **County:** The County where the contracted work is located.

36. **Culvert:** Any structure that provides an opening under the roadway not meeting the classification of a bridge as defined in this section.

37. **Debarment:** Action taken by the Department or federal government pursuant to regulations that prohibits a person or company from performing work on a public project.

38. **Delay:** Any event, action, or factor causing work to extend beyond the specified contract time.

    a. **Excusable Delay:** A delay beyond the Contractor's control and not caused by the Contractor's fault or negligence and 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, work suspensions caused by conditions beyond the control of the Contractor, lack of site access, and delayed shop drawing approval. For such delays, the Department may grant additional time and compensation.

2) **Noncompensable Delay:** An unforeseen and unanticipated excusable delay caused by acts of God, acts of public enemies, fires, floods, epidemics, quarantine restrictions, area wide strikes, freight embargoes, unusually severe weather, or delays not caused by the Contractor's or the Department's fault or negligence. For such delays, additional compensation will not be granted.

a) **Concurrent Delay:** A noncompensable delay that occurs when both the Contractor and the Department independently delay work on critical path activities during approximately the same time period.

b. **Nonexcusable 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.

39. **Department:** The Utah Department of Transportation

40. **Differing Site Conditions:** Subsurface or latent physical conditions at the project site that:
    a. Differ significantly from those indicated in the contract, or
    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.

41. **Electronic Communication:** A communication transmitted through facsimile (fax), e-mail, or other electronic means where a hard copy can be produced.

42. **Engineer:** The UDOT Deputy Director, acting directly or through a duly authorized representative, usually the Resident Engineer or Consultant Engineer, responsible for engineering and administrative 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.

43. **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.
44. **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 its intended scope.
45. **Final Acceptance:** The date when the Engineer determines that all requirements of physical completion, as defined in this section, are satisfactorily completed.
46. **Force Account:** A method of payment for work performed by the Contractor at the Engineer's direction, calculated as specified in Section 01282.
47. **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.
48. **Highway, Street, or Road:** A general term denoting a public way used by vehicles and pedestrians, including the entire area within the right-of-way.
49. **Holidays:**

New Year's Day	Labor Day
Martin Luther King Day	Columbus Day
Presidents' Day	Veteran's Day
Memorial Day	Thanksgiving Day
Independence Day	Christmas Day
Pioneer Day	

When the Holiday falls on a Saturday, Friday will be the Holiday. When the Holiday falls on Sunday, Monday will be the Holiday.

50. **Inspector:** The Engineer's authorized representative assigned to inspect work and materials.
51. **Interpretations:** Unless otherwise stated in the contract, all direction, approvals, permissions or acceptance is by the Engineer.
52. **Invitation for Bids:** The advertisement requesting bids for work or materials. It estimates quantities, specifies the location of the work, character and quantity of the materials to be furnished and the time and place of the opening of bids.
53. **Laboratory:** The Department testing laboratory or any other testing laboratory designated by the Engineer.
54. **Lane Rental:** A method to assess the Contractor rental fees for each lane, shoulder, or combination of lanes and shoulders taken out of service.
55. **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 inconvenience to the public, added cost of engineering and supervision, and other items

for extra expenditures of public funds for the Contractor's failure to perform as specified.

56. **Major Contract Item:** Any individual bid item, or item added by change order, having a contract value in excess of five percent of the original contract amount.
57. **Materials:** Substances specified for use in project construction.
58. **Notice to Proceed:** Written notice to the Contractor to begin the contract.
59. **Overburden:** Any material that overlays material designated for road or bridge construction.
60. **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 of which 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.
    d. **Subgrade:** The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.
    e. **Subgrade Treatment**: Stabilization of roadbed material.
61. **Physical Completion:** Physically complete. 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; the date determined by the Engineer when final acceptance is established and the Contractor's only outstanding obligation under the contract is submitting or processing documentation.
62. **Plan Quantity:** An estimated quantity for a portion of the work designated as the pay quantity for the contract. Refer to Section 01280.
63. **Plans:** Approved contract drawings showing the location, type, dimensions, and details of the specified work.
    a. **Standard Drawings**: Detailed drawings approved for repetitive use.
    b. **Working Drawings:** Supplemental design sheets or similar data that the Contractor is required to submit to the Engineer such as shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, and bending diagrams for reinforcing steel.

64. **Prequalification/Initial Financial Screening Statement:** The specific forms on which required information is furnished about the Contractor's ability to perform and finance the work.
65. **Price + Time Bidding (P+T):** A price-plus-time bidding procedure.
66. **Profile Grade:** The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.
67. **Project:** The specific section of the highway or other specific property on which construction is to be performed together with all improvements to be constructed under the contract.
68. **Proposal:** A bidder's written response to a Department request for proposals. See also Value Engineering Change Proposal.
69. **Responsible Bidder:** A bidder able to perform the specified work as determined by the Department.
70. **Responsive Bid:** A bid that meets all requirements of the invitation for bids.
71. **Resources:** The labor, equipment, materials, and incidentals necessary to perform work on a contract bid item or other element of work.
72. **Right-of-Way:** A general term denoting land, property, or interest acquired for or devoted to transportation purposes.
73. **Roadbed:** The graded portion of highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.
74. **Roadbed Material:** Material in cuts, embankments, and embankment foundations from the subgrade down that supports the pavement structure.
75. **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.
76. **Roadside Development:** Items necessary for the preservation or replacement of landscape materials. Features may include suitable plantings and other improvements or ground cover to preserve and enhance the appearance and stability of the highway right-of-way or acquired easements for scenic improvements.
77. **Roadway:** The portion of a highway within the construction limits.
78. **Shoulder:** The portion of the roadway adjacent to the traveled way where vehicles may stop for emergencies and which supports base and surface courses.
79. **Sidewalk:** That portion of the roadway constructed exclusively for pedestrian use.
80. **Significant Change in Character of Work:** Work that differs materially in kind or nature from that involved or included in the original contract or results in the total quantity of a major contract

item, as defined in this section, varying from the original contract quantity by more than 25 percent.

81. **Site of Work:** As defined in Title 29 CFR Part 5.2 (1).
82. **Specifications:** The compilation of provisions and requirements for the performance of prescribed work.
    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.
83. **Specifications Format:** See the Specification Writer's Guide. Refer to: http://www.udot.utah.gov/go/standardsreferences. The titles or headings of the sections, parts, articles, paragraphs, and sub-paragraphs in Standard Specifications and Special Provisions are intended for convenience of reference and have no bearing on their interpretation.
84. **Stabilization:** Modification of soils or aggregates by incorporating materials that increases load-bearing capacity, firmness, and resistance to weathering or displacement.
85. **State:** The State of Utah acting through its authorized representative.
86. **Structures:** Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains, and other such features that may be encountered in the work.
87. **Subcontractor:** An individual or legal entity to which a Contractor sublets part of the work.
88. **Substantial Completion:** Substantially complete. The day, determined by the Engineer, when all of the following have occurred:
    a. The public, including vehicles and pedestrians, has full and unrestricted use and benefit of the facilities both from the operational and safety standpoint.
    b. All safety features are installed and fully functional, including, but not limited to, illumination, signing, striping, barrier, guardrail, impact attenuators, delineators, and all other safety appurtenances,
    c. Only minor incidental work, replacement of temporary substitute facilities or correction or repair remains for physical completion.
    d. The Contractor and Engineer mutually agree that all work remaining will be performed without lane closures, trail or sidewalk closures, or further delays, disruption, or impediment to the public.

89. **Substructure:** All of the structure below the girders or main load carrying members of simple and continuous span bridges, including abutments, bent caps, columns, bents, footings, wingwalls, and skewbacks of arches.
90. **Superintendent:** The Contractor's authorized employee in responsible charge of the work.
91. **Superstructure:** All of the structure except the substructure as defined in this section.
92. **Surety:** The legal entity or individual, other than the Contractor, executing a bond furnished by the Contractor.
93. **Time Related Cost (Time component):** A lump sum bid item titled "Time" for which there is no pay. The sum of the products of the daily time-related cost rates multiplied by the number of days estimated by the Contractor to achieve the milestones specified.
94. **Town, City, or District:** A subdivision of the county used to designate or identify the location of the contract.
95. **Traveled Way:** The portion of the roadway designated for the movement of vehicles, excluding shoulders and auxiliary lanes.
96. **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 bidder'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 bidder will result in the lowest ultimate cost to the Department.
97. **Unrestricted Traffic**: No traffic control measures in use that obstruct, delay, or in any way impede traffic flow, other than those specifically permitted in the contract.
98. **Utility:** All privately, publicly, or cooperatively owned lines, facilities, and systems for producing, transmitting, or distributing communications, power, heat, gas, oil, water, waste, storm water not connected with the highway drainage, signal systems, and other products that directly or indirectly serve the public. The utility company.
99. **Value Engineering Change Proposal:** A change proposed by the Contractor and considered by the Department intended to result in a cost savings to the project without reducing the essential functions and characteristics of the project. Refer to Section 00725.
100. **Work:** All labor, materials, equipment, documents, elements, activities, and incidentals necessary to complete the contract, including all alterations, amendments, or extensions made by change order or other written orders of the Engineer.

101. **Working Day:** Any calendar day, except:
   a. Saturdays, Sundays, and contract-designated holidays.
   b. Days between December 1 and February 29, inclusive.
   c. Days when the Contractor is specifically required by the contract or letter from the Engineer to suspend operations through no fault of the Contractor.
   d. 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 with at least 75 percent of the normal labor and equipment force engaged in the work for at least 60 percent of the normal working day.
      2) When inclement weather stops the Contractor from beginning work at the normal starting hour and the crew is released as a result, it is not considered a working day even though conditions may improve and the major portion of the day could be considered suitable for operations.
102. **Working Drawings:** See "Plans."
103. **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 00725

SCOPE OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00570: Definitions

C. Section 00727: Control of Work

D. Section 01282: Payment

E. Section 01355: Environmental Protection

F. Section 01554: Traffic Control

G. Section 01741: Final Cleanup

1.3 REFERENCES

A. UDOT and Utah AGC Partnering Field Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

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 PARTNERING

A. The Department encourages partnership between the Department, the Contractor, and the subcontractors. This partnership uses the strengths of each organization to identify and achieve mutual goals.

B. Implement partnering in accordance with the UDOT and Utah AGC Partnering Field Guide. Refer to http://www.udot.utah.gov/go/standardsreferences.

1. Decide with the Engineer whether to use an independent third party firm to implement facilitated partnering or to share in facilitation.
   a. Contact the Engineer within 30 days of Notice of Award and before the preconstruction conference to implement a third party facilitated partnering initiative.
2. The Contractor and Engineer select a facilitator for the meeting and develop attendees list, agenda, duration, and location of a partnering workshop.

C. Share any costs equally with the Department to accomplish partnering.

D. Follow-up workshops may be held as agreed by the Contractor and the Engineer.

1.8 DIFFERING SITE CONDITIONS, CHANGES, AND REQUESTS OR CLAIMS FOR ADDITIONAL COMPENSATION

A. Immediately notify the Engineer verbally of alleged changes to the contract due to differing site conditions, extra work, altered work beyond the scope of the contract, actions taken by the Department that change the contract terms and conditions, or upon discovering any other unforeseen condition or event that may result in a request or claim for additional compensation or time.

1. Refer to Section 00555 for determining compensation and contract time extension for excusable delays.
2. Leave the site undisturbed and suspend work unless directed otherwise when differing site conditions on the project are encountered.
3. Obtain written authorization from the Engineer to perform affected work and incur contract item expense after discovering the change, condition, or event.

B. Notification Requirements:

1. Provide the following information in writing within seven calendar days of when the change, condition, or event resulting in the request or claim for additional compensation is discovered.
   a. Date, nature, and circumstances causing the change, condition, or event.
   b. Name, title, and activity of each Department representative aware of the change, condition, or event.
   c. Identify documents and the substance of discussions about the change, condition, or event.

d. Basis for a claim that the work is not required by the contract.

e. Particular elements of contract performance for which compensation is being requested including:

1) Pay items that have been or may be affected by the change, condition, or event.

2) Labor or materials that will be added, deleted, or wasted by the change, condition, or event, and equipment that will be idled or added.

3) Existing or anticipated delays and disruptions in contract performance, procedure, or order.

4) Estimate of the time within which the Department must respond to the notice to reduce project cost, delay, or disruption.

2. Failure to provide written notification within seven calendar days of when the change, condition, or event is noticed will 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 any claim resulting from the alleged change, condition, or event.

C. Notify the Engineer and 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 seven 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. The Engineer responds to additional information within seven calendar days of receipt.

1) Any contract adjustments will exclude increased costs or time extensions resulting from the Contractor's failure to provide the requested information.

D. Contract adjustment is made as written modification to the contract through change order when warranted, unless the Contractor does not notify the Engineer in accordance with this article.

1. Loss of anticipated profits are excluded.

E. No contract adjustment that benefits the Contractor is allowed unless the Contractor has provided written notice in accordance with this article.

F. The Contractor may pursue a claim for additional compensation or contract adjustment If the Engineer decides a contract adjustment identified by the Contractor is unnecessary and the Contractor does not agree with the Engineer's decision. Refer to Section 00727.

1.9 VARIATION IN QUANTITIES AND SIGNIFICANT CHANGE IN CHARACTER OF WORK

A. The Engineer reserves the right at any time during the work to revise the contract and make written changes in quantities and alterations in the work that are necessary to satisfactorily complete the project.
   1. Such changes in quantities and alterations do not invalidate the contract or release the surety and the Contractor agrees to complete the work as altered.
   2. Do not proceed with the revised work without the Engineer's written authorization.
   3. Proceed immediately with the revised work upon receiving written approval.

B. Meet notification requirements under this section, article 1.5, when requesting compensation or adjustment to the contract under this article.
   1. No contract adjustment that benefits the Contractor is allowed unless the Contractor has provided written notice in accordance with this section.

C. Payment will be made at contract prices when the total quantity of any item of work varies from the bid quantity by 25 percent or less.

D. Payment will be made at the contract prices when the total quantity of any item of work varies from the bid quantity by more than 25 percent and the alterations or changes in quantities do not represent a significant change in character of work to be performed under the contract.

E. The term "significant change in character of work" applies only to the following circumstances:
   1. The character of the altered work differs materially in kind or nature from that involved or included in the original contract.
   2. The total quantity of a major contract item, as defined by Section 00570, varies from the original contract quantity by more than 25 percent.
      a. An adjustment in price may be made to the contract at the request of either party.

b. Any price adjustment for an increase in quantity applies only to that portion in excess of 125 percent of the original contract quantity.
   1) 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.

c. Any adjustment for a decrease in quantity below 75 percent of the contract quantity is limited to the actual quantity of work performed.
   1) Fixed costs in the original contract may be considered when establishing the adjustment.
   2) Payment for the work will in no case exceed the payment that would have been made for the performance of 75 percent of the original item quantity at the contract price.

F. 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. Alterations or changes can be significant changes to the character of work or by their effect cause other work to become significantly different in character.
   2. Agree upon the basis for contract adjustment before beginning work.
      a. The Engineer may order the work to proceed under the force account provisions of Section 01282 if a basis for adjustment cannot be agreed upon.
   3. Contract time is adjusted in accordance with Section 00555 for directed changes that require additional time to complete.
   4. Adjustments may be either for or against the Contractor in such an amount the Engineer may determine to be fair and equitable.

G. The Contractor may pursue a claim for additional compensation or contract adjustment if the Engineer decides a contract adjustment identified by the Contractor is unnecessary and the Contractor does not agree with the Engineer's decision. Refer to Section 00727.

1.10 WORK SUSPENSIONS ORDERED BY THE ENGINEER

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.
   1. Submit a written request to the Engineer for a contract adjustment for suspensions or delays considered unreasonable or atypical to the construction industry. Refer to Section 00555.
      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 in accordance with Sections 00555 and 01282 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 the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier.
      c. Was not caused by weather.

B. The Contractor may pursue a claim for additional compensation or contract adjustment if the Engineer decides a contract adjustment due to the suspension of work is unnecessary and the Contractor does not agree with the Engineer's decision. Refer to Section 00727.

1.11 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. Provide traffic control. Refer to Section 01554.
   2. Maintain all necessary accesses to parking lots, garages, businesses, residences, farms, etc.
   3. Exclude snow removal.

B. The Department does not additionally compensate for maintenance except for specific work directed by the Engineer to benefit the traveling public.

C. Suspensions ordered by the Engineer:
   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 for events beyond the Contractor's control during work suspensions at contract prices or as extra work.

D. Other Suspensions of Work:
1. Maintain the roadway at no additional cost to the Department to accommodate traffic during suspensions resulting from:
   a. Seasonal or climatic conditions.
   b. Failure to correct conditions unsafe for the workers or the general public.
   c. Failure to perform work ordered by the Engineer.
   d. Other reasons caused by the Contractor.

E. 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 the Contractor.

1.12 USE OF ON-SITE MATERIALS

A. Obtain approval before using excavated materials found on the work site that are suitable for completing other bid items of work. 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.
1. The Department does not charge for the materials used.
2. Obtain written approval before excavating material outside grading limits.

B. Replace excavated material used for completing other bid items of work with acceptable material at no additional cost to the Department.

C. Unless otherwise specified in the contract, salvageable material is the property of the Contractor.

1.13 FINAL CLEANUP

A. Clean all rubbish, excess materials, temporary structures, and equipment from the highway, project, borrow and local material source sites, and all areas occupied in connection with the work before final inspection and acceptance.
   1. Refer to Section 01741 for requirements.

1.14 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.

B. Repair damage caused by the permit holder when directed by the Engineer. The Department pays for repair work as extra work or as provided in the contract.

1.15 RAILWAY – HIGHWAY PROVISIONS

A. The Department arranges with the railway for new crossings or for existing crossings used during the work.

B. The Department does not reimburse for railroad flagging and inspection.

C. Hold a preconstruction conference 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 project plans for names of railroad companies.

D. Give at least 48 hours verbal notice to the Manager of Track Maintenance or equivalent position for the railroad company having responsibility for the area the project is in before beginning work once the work dates have been established.

E. Execute a Contractor's Right of Entry Agreement with the railroad company before performing any work within the railroad right-of-way.
   1. Provide all insurance required under the Contractor's Right of Entry Agreement.
   2. Provide executed copies of this agreement to the Engineer.

F. Determine the cost of required railroad flagging, inspection, and cleanup crew. Include these costs in mobilization.

G. The Department deducts payment under a construction accounting item for “Railroad Flagging, Inspection, and Cleanup” and pays the railroad directly for verified billings. No other compensation to the Contractor for this item is allowed.

1.16 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.

1.17 CONTRACTOR’S RESPONSIBILITY FOR WORK

A. Maintain and protect the work included in the contract against injury or damage from all causes whether or not related to performing the work until project final acceptance.

B. Rebuild, repair, restore, and make good all losses, injuries, or damage to any portion of the work under the control of the Contractor at no additional cost to the Department before receiving final acceptance.

C. Rebuild, repair, restore, and make good all losses, injuries, or damage to any portion of the work not under the control of the Contractor, under agreed unit prices or as extra work under Section 01282.
   1. Items not under the Contractor’s control include, but are not limited to, acts of God, acts of public enemies, acts of governmental authorities, fires, floods, unusually severe weather, damage caused by third party errant vehicles, and vandalism.

D. When 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.

1.18 ENVIRONMENTAL PROTECTION

A. Refer to Section 01355.

1.19 CONTRACTOR PROPOSALS FOR VALUE ENGINEERING

A, The Contractor and the Department equally share the savings resulting from a Value Engineering Change Proposal (VECP) offered by the Contractor and approved by the Department.

B. The Department considers VECPs that may potentially result in savings and preserve essential functions and characteristics of the facility, including, but not limited to service life, economy of operation, ease of maintenance, desired capacity, and safety.

C. Base contract bid prices on specified work rather than on VECPs subject to Department approval. Complete the contract as bid if a VECP is rejected.

D. Submitting Proposals:

1. Submit the following materials and information with each proposal:
   a. A statement that the submission is a VECP.
   b. A description of the existing work and the proposed changes for performing the work. Discuss the comparative advantages and disadvantages of each.
   c. A complete set of plans and specifications showing proposed revisions to the original contract.
   d. A detailed cost estimate for performing the work under the existing contract and under the VECP.
   e. A time frame within which the Department must make a decision.
   f. A statement of the probable effect the VECP will have on the contract completion time.
   g. 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.
2. The Department determines and notifies the Contractor within five working days when there is insufficient review time for a response.
3. The Department may consider a non-compensable delay adjustment to the contract based on the additional review time necessary and its effect on the Contractor's schedule.
4. The Contractor has no claim against the Department for compensable or non-compensable delay if the Department fails to respond within the time indicated in this article when additional information requested from the Contractor is necessary to complete the review.

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.
      b. The Department may duplicate or disclose any data necessary to use the VECP.
      c. The Department may apply a proposal for general use on other contracts it administers without obligation to the Contractor.
      d. This provision does not deny rights provided by law with respect to patented materials or processes.
   3. Use only proven features that have been employed under similar conditions or projects acceptable to the Department.

F. The Department decides whether or not to consider a VECP. The Department may reject a VECP that requires excessive review, evaluation or investigation, or that is inconsistent with project design policies or criteria. The Department rejects VECPs that:
   1. Provide equivalent options to those already in the contract.
   2. Contain revisions the Department is already considering or has approved for the contract.
   3. Do not generate sufficient savings.
   4. Do not provide additional information as requested by the Department, including requests for field investigation results and surveys, design computations, and field change sheet for proposed design changes.
   5. Relate to pavement section thickness or type.

G. The Contractor has no claim to additional costs or delays including development costs, loss of anticipated profits, or increased material or labor costs if the VECP is rejected.

H. The Engineer rejects unsatisfactory work resulting from an approved VECP.
   1. Remove rejected work and reconstruct under the original contract provisions without reimbursement for the work performed under the VECP or for its removal.
   2. Reimbursement for approved modifications to the VECP to adjust to field or other conditions is limited to the total amount payable for the work under the contract bid prices.
   3. Rejection or limitation of reimbursement is not basis for any claim against the Department.

I. 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.

J. The Department pays by change order for VECPs approved in whole or in part.
   1. The contract 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 the Contractor 50 percent of the savings between cost of the revised work and the original bid price.
   3. The Department does not reimburse costs to develop, design, and implement the VECP.
   4. Only the Contractor may submit VECPs and be reimbursed for savings. The Contractor may submit VECPs for an approved subcontractor.

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 Not Used

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00725: Scope of Work

C. Section 01282: Payment

D. Section 01721: Survey

1.3 REFERENCES

A. Utah Code Title 63, Chapter 56 – Utah Procurement Code

B. Utah Regulations for Legal & Permitted Vehicles

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

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 final acceptance, and acceptable contract completion.

B. The Engineer has the authority to suspend 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, or
   2. Perform work properly or comply with contract provisions, or
   3. Comply with the Engineer's orders

C. The Engineer can suspend work wholly or partially for:
   1. Periods of unsuitable weather, or

2. Conditions unsuitable for the prosecution of the work, or
3. Any other condition or reason determined to be in the Department's interest

1.7 PLANS AND WORKING DRAWINGS

A. Keep at least one complete set of plans, specifications, and standard drawings on the project site at all times.

B. Furnish to the Department structure plans with working drawings that detail required work not included in the contract plans.

C. Include the cost of furnishing all working drawings in the related contract bid items.

1.8 PLANS AND SPECIFICATIONS CONFORMANCE

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

B. The Engineer decides the extent to which the work will be accepted and remain in place when a contract item does not meet contract requirements but is adequate to serve the design purpose. The Engineer documents the basis of acceptance and adjusts the contract unit price.

C. The Department uses the specified pay adjustment factors for payment when the contract provides for acceptance of a contract item not complying fully with the minimum requirements.

D. Remove, replace, or correct work at no cost to the Department when a contract item does not meet specified requirements and results in work inadequate to serve the design purpose.

1.9 COORDINATE PLANS, STANDARD SPECIFICATIONS, AND SPECIAL PROVISIONS

A. All supplementary documents are essential parts of the contract and a requirement occurring in one is binding as though occurring in all. Supplementary documents are complementary and provide and describe the complete contract.

B. The governing ranking in case of a discrepancy is:

Dimensions	**Information**
1. Plan	1. Special Provisions
2. Calculated	2. Plans
3. Scaled	3. Supplemental Specifications
	4. Measurement and Payment
	5. Standard Specifications
	6. Standard Drawings

C. Do not take advantage of any apparent error or omission in the contract.

D. Notify the Engineer promptly of any omissions or errors in the contract so that necessary corrections and interpretations can be made.

1.10 CONTRACTOR COOPERATION

A. Facilitate progress of the work and cooperate with Department inspectors and other contractors.

B. Employ a competent superintendent experienced with the work being performed and capable of reading and understanding the contract documents.
   1. The superintendent must have completed the Department's Partnering Training or be registered for and attend the next available training session.

C. The superintendent must be:
   1. Present at the project site at all times that work is being performed.
   2. Authorized to act as an agent for the Contractor and execute instructions and directions from the Engineer or authorized representatives.

D. Supply all necessary resources to complete the contract regardless of the amount of work sublet.

1.11 UTILITIES COOPERATION

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 in the contract plans.

C. Use work procedures that protect utilities or appurtenances that remain in place during construction.

D. The Department notifies utility companies, pipeline owners, or other utility agencies affected by the work to verify that all utility adjustments, within or adjacent to the construction limits, are made as soon as possible.

E. 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. Work around fire hydrants only after obtaining approval by the local fire authority and then only after making provisions for continued service.

F. Repair damages to utilities that result from carelessness or omission. Restore damaged facilities to the preexisting condition at no additional cost to the Department.

G. Adjust or relocate utility facilities or appurtenances found but not noted in contract documents when directed by Engineer.

1.12 COOPERATION BETWEEN CONTRACTORS

A. The Department reserves the right to contract for and perform other or additional work on 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 the contract.

D. Each Contractor protects and holds the Department harmless from any damages or claims caused by inconvenience, delay, or loss 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.

1.13 DEPARTMENT-PROVIDED CONTROL POINTS AND ELEVATION BENCH MARKS

A. The Department provides control points and elevation benchmarks.

B. Replace disturbed control points and elevation benchmarks at no expense to the Department.

1.14 CONSTRUCTION SURVEY

A. Perform the Construction Surveying necessary to properly control the entire work. Refer to Section 01721.

1.15 INSPECTOR DUTIES

A. Department inspectors are authorized to inspect all work and materials furnished.
   1. Inspection may extend to 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 reject work or materials until any issue in question can be referred to and decided by the Engineer.

1.16 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. Remove and replace work performed or materials used without inspection by an authorized Department representative at Contractor expense, if ordered by the Engineer.
   1. Remove and uncover portions of finished work as directed.
   2. Once inspected, restore work to contract requirements.
      a. The Department pays for the additional cost to uncover, remove, and replace or make good the parts removed as extra work, if the uncovered work is found acceptable.
      b. The Department does not pay for additional costs to uncover, remove, and replace the covering, or make good the parts removed, if the work is found unacceptable.

C. Initial failure by the Engineer to reject defective work or materials either from lack of discovery or any other reason does not prevent the later rejection when such defect is discovered or obligate the Department to the accept the final work or materials.
   1. The Department is not responsible for losses suffered due to necessary removals or repairs of such defects.

D. The representative of a government agency, utility, or railroad company that will pay a portion of the contract cost may inspect that portion of the work. 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.

1.17 UNACCEPTABLE AND UNAUTHORIZED WORK REMOVAL

A. Remove and replace any unacceptable work before final acceptance.
   1. Work is considered unacceptable if it does not meet the contract requirements unless accepted under this section, article 1.5.

B. 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 expense.

1.18 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.
   2. Refer to the Utah Regulations for Legal & Permitted Vehicles.

B. Do not apply weight restrictions to equipment or materials hauled over subgrade.

C. Do not exceed legal gross weight limits on any public roads, structures, or on any component of the pavement structure excluding granular borrow.

D. Suspend construction operations when load restriction violations are observed until the Engineer approves acceptable corrective measures.

E. 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.

F. For materials imported to the job site such as asphalt, cement, concrete, steel, etc.:
   1. Provide the Engineer with invoices showing the gross load weights.
   2. The Department withholds payment for material used in the project if invoices are not provided.
   3. The Engineer notifies the appropriate enforcement agency if it is suspected that legal gross load limits are exceeded.

1.19 MAINTAIN THE WORK DURING CONSTRUCTION

A. Maintain all work included in the contract during construction until final acceptance.
   1. Maintain traffic detour routes and project travel ways in accordance with the Traffic Control Plan.

B. The Engineer immediately notifies the Contractor of failure to meet these provisions.
   1. The Engineer 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.

C. Include in the bid unit prices the cost of maintaining work during construction until final acceptance.

1.20 OPEN PROJECT SECTIONS TO TRAFFIC

A. The Engineer may order certain sections of work opened to traffic before completion or acceptance of the work.

B. Opening 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 by order of the Engineer.
   1. Contractor is paid in accordance with Section 01282 when the ordered opening to traffic is not the result of Contractor fault or inactivity.
   2. The Department prepares a change order when the opening is not provided for in the contract. The Department does not compensate the Contractor if the order to open is the result of Contractor fault or inactivity.

D. Engineer gives written notice establishing a time period for completing features of the work for which the Contractor is late.
   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 liability and responsibility for maintaining the work and conduct the remaining construction operation with minimum interference to traffic without additional compensation.

1.21 FURNISH RIGHT-OF-WAY

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

1.22 PROJECT ACCEPTANCE

A. Partial Acceptance
   1. The Contractor may request acceptance of a unit when:
      a. A unit or portion of the project is substantially complete.
      b. The unit or portion is considered or determined necessary for the convenience of traffic such as a structure, interchange, roadway section, intersection, substation, or portion of highway lighting or traffic signal systems.
   2. The Engineer may make written acceptance of a unit as complete if the unit has been completed according to the contract and relieve the Contractor of further responsibility for that unit.
   3. Partial acceptance neither voids nor alters any contract terms.

B. Substantial Completion
   1. Request inspection and verification by the Engineer when the project is substantially complete.
      a. The Engineer performs an inspection and identifies any necessary corrective work and work necessary for physical completion.
      b. The Engineer notifies the Contractor in writing and stops contract time when the project is found to be substantially complete.
      c. Immediately comply with and execute instructions given by the Engineer if the inspection discloses any unsatisfactory work.
      d. Execute all work necessary for physical completion within 30 calendar days of the substantial completion date in accordance with Section 00555.

C. Final Acceptance
   1. Request inspection and verification by the Engineer when the project is physically complete.
      a. The Engineer performs the final inspection and identifies any necessary corrective work.
      b. Immediately comply with and execute instructions given by the Engineer if the inspection discloses any unsatisfactory work.
      c. The Engineer notifies the Contractor in writing of the date of final acceptance when the project is determined to be physically complete and identifies any documents required to complete the contract.
      d. Furnish all documentation identified by the Engineer to complete the contract within 30 days of notification of final acceptance in accordance with Section 00555.
      e. The Engineer notifies the Contractor in writing of the date of contract completion.

1.23 ADDITIONAL COMPENSATION OR CONTRACT ADJUSTMENT CLAIMS

A. Notify the Engineer in writing of any 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 under Section 00725.
   2. The Engineer responds as described for differing site conditions changes, and requests or claims for additional compensation under Section 00725.

B. Work closely with the Engineer during notification, review, and evaluation to resolve the contract question and avoid further claims.

C. The Contractor waives any claim for additional compensation if the Engineer is not notified or is not afforded proper facilities for strict accounting of actual costs.
   1. Notifying the Engineer and accounting of costs does not substantiate the claim's validity
   2. The contract will be adjusted only if the claim is found to have merit.

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 submitted:
   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. Name, title, and activity of each Department employee knowledgeable about facts that are the basis of the claim.
4. Name, title, and activity of each Contractor employee knowledgeable about facts that are the basis of the claim.
5. The specific contract provisions that support the claim and a statement of why they support it.
6. Identification of pertinent documents and the substance of any relevant verbal communications relating to the claim.
7. A statement whether the additional compensation or extension of time is based on contract provisions or an asserted breach of contract.
8. For time extension or compensation for delay requests, include:
    a. The specific days for which a time extension is requested.
    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 Section 00555.
9. Exact amount and specifics 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 cost on rates claimed for each piece of equipment.
        2) The rates for the equipment in use cannot exceed the force account rates in the absence of actual equipment cost. Refer to Section 01282.
    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.

10. 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 _____/s/_____
Subscribed and sworn before me this _____day of _____
Notary Public_____
My Commission Expires _____

E. Failure to either submit information and details as described in this section for any claim or failure to submit any claim before the date of final acceptance constitutes a waiver of the claim.

1.24 CLAIMS RECORD KEEPING

A. Maintain complete records 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 acceptance.

1.25 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. The audit may begin at any time during the life of the contract, or 20 calendar days after notice is provided to the Contractor, the subcontractors, or the Contractor's agents if more than 60 calendar days after the final acceptance date of the contract have elapsed.

C. Provide adequate facilities acceptable to the Engineer for the audit during normal business hours. Cooperate with the auditors.

D. Failure of the Contractor, subcontractors, or agents 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 of the Contractor, subcontractors, or agents constitutes a waiver of the claim and bars any recovery.

E. As a minimum, make the following documents available to auditors:
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 list of company equipment, rates, etc.
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 the Contractor's internal purposes to establish the actual cost of owning and operating equipment used in performance of the work
19. All documents related to preparing the Contractor's 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

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

1.26 CLAIMS HIGHER LEVEL REVIEW

A. Provide written notification to the Engineer within 10 calendar days of the Engineer's denial of a claim requesting a higher-level review, when not accepting the Engineer's denial action.

B. Failure to submit a request within this 10-day time frame is considered acceptance of the Engineer's denial action.

1.27 CLAIMS REVIEW BOARD

A. Pursue administrative resolution of any claim with the Engineer or the designee of the Engineer.

B. The Director for Construction and Materials schedules a hearing before the Department Claims Review Board when deemed to be in the best interest of both the Contractor and the Department if no agreement is reached and at the Contractor's written request to the Engineer.
   1. The claim may be presented informally with or without legal counsel.
      a. Notify the Department at least 10 calendar days before the hearing when using legal counsel.

C. The Board makes recommendations and outlines their reasoning to the UDOT Deputy Director within 30 calendar days after the claim hearing.

D. The UDOT Deputy Director makes an offer of settlement within 45 calendar days after the claim hearing.

E. The decision of the UDOT Deputy Director is administratively final.

F. The Contractor has the option of rejecting and appealing the Department's decision to the State Procurement Appeals Board in accordance with Utah Code Title 63, Chapter 56 – Utah Procurement Code.

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 00570: Definitions

C. Section 01355: Environmental Protection

D. Section 01554: Traffic Control

1.3 REFERENCES

A. Code of Federal Regulations (CFR)

B. Manual of Uniform Traffic Control Devices (MUTCD)

C. OSHA Safety and Health Regulations for Construction

D. UDOT Construction Safety and Health Manual

E. UDOT Owner Controlled Insurance Program (OCIP)

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 and State Laws
   2. Local laws, ordinances, and health officials
   3. Regulations, orders and decrees of bodies or tribunals having any jurisdiction or authority
   4. UDOT Construction Safety and Health Manual

B. Protect and indemnify the Department and its representatives against claim or liability arising out of or resulting from violations of any of the above listed items, whether violated by employees, agents, or contractors of the following:
   1. The Contractor
   2. Subcontractor at any tier
   3. Suppliers of materials or services
   4. Any others engaged by the Contractor

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 OSHA 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 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.

F. Immediately notify the Engineer in writing 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.

1.7 USING EXPLOSIVES

A. Comply with all laws and ordinances and specifically Title 29 CFR Part 1926 - Safety and Health Regulations for Construction (OSHA), Title 30 CFR, and the UDOT Construction Safety and Health Manual, whichever is the most restrictive, in the use, handling, loading, transportation, and storage of explosives and blasting agents.

B. Do not endanger life, property, or work with the use of explosives.

C. Accept liability for property damage, injury, or death resulting from the use of explosives.

D. Notify property owners and public utility companies in the vicinity of the proposed detonation before using any explosives.

1.8 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. Keep the project site orderly and clean.

C. Obtain all required permits.

D. Prevent and assist with the suppression of forest fires.

E. Cooperate with responsible forestry officials.

1.9 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.

B. Include these costs in the appropriate unit prices bid for the contract items.

1.10 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 and hold harmless the Department and any affected third party or political subdivision from claims of infringement of patents, copyrights, or trademarks.

C. Indemnify the Department for costs, expenses, and damages, which it may be obligated to pay as a result of an infringement during the conduct of the work or after the project is completed.

1.11 FEDERAL AID PARTICIPATION

A. Federal requirements of a federally assisted contract supersede conflicting provisions of laws, rules, or regulations.

B. The Department supervises all work but appropriate Federal officials inspect and approve the work when there is Federal participation in the contract. The U.S. Government, however, is not a party to the contract and will not interfere with the rights of contract parties.

1.12 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 ensure 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 in accordance with MUTCD 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 project traffic control plan.
   2. Obtain approval before dismantling or removing traffic control devices.

E. For Pedestrians:
   1. Place and maintain warning signs under project traffic control plan.
   2. Provide pedestrian access in areas where construction interferes with existing pedestrian access.

1.13 PROTECTING AND RESTORING PROPERTY AND LANDSCAPE

A. Preserve public and private property during the work.

B. The Engineer verifies reference to the location of monuments and property line markers before they are moved, disturbed, or damaged.
   1. Obtain written approval from the Engineer before moving or disturbing any monuments or markers.

C. Accept liability for any damage to public or private property resulting from defective work, materials, or non-execution of the contract.
   1. Maintain liability until the project is accepted.

D. Restore damaged property to a condition similar or equal to that existing before the damage at no additional cost to the Department.

E. Temporarily discontinue work if remains of prehistoric dwelling sites or artifacts of historical or archeological significance are encountered. Refer to Section 01355.

1.14 THIRD-PARTY BENEFICIARY CLAUSE

A. This contract does not authorize anyone who is not a party to this contract the right to maintain an action for damages under its provisions or to any of the rights of a third-party beneficiary. However, this contract does 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.

1.15 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. They are not liable either personally or as employees of the Department for actions in their ordinary course of employment.

1.16 NO WAIVER OF LEGAL RIGHTS UPON COMPLETION

A. Upon completion of the contract, the Department makes final inspection and notifies the Contractor of acceptance.
   1. Final 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. Even after completion, 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.

1.17 RESPONSIBILITY FOR DAMAGE CLAIMS

A. Protect, indemnify, and hold the State of Utah, the Department, and their officers, agents, and employees (State) harmless 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. The Department may require that the Contractor represent its interests or may choose to have separate counsel. If the Department has its own counsel, the Department pays for its own attorneys' fees, costs, and expenses. Upon determination by the court of the proportionate liability for the claim, total defense costs will be apportioned accordingly. For example, if the court finds the Department to be 60 percent liable for the claim and the Contractor 40 percent liable, then the Department pays 60 percent of the total defense costs while the Contractor pays 40 percent.

C. Contractor and the Department agree to provide each other with a copy of the summons and complaint within two business days of receipt if served with a lawsuit or Notice of Claim. Do not file a responsive pleading on behalf of the Department until receiving written notice that the Department chooses to have Contractor handle the defense. 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, article 1.15 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. Comply with the following insurance claims notification and processing procedures:

1. Notify the Engineer of all claims within seven days of notification.
2. Provide written notification for all pending claims to the Engineer before the final acceptance of the project.
3. Notify claimants of denied or partially denied claims of $5,000 or less of their right to request re-examination by the

   UDOT Claims Re-Examination Board
   4501 South 2700 West
   West Valley City, UT 84114-8430
   Phone: (801) 964-4556

   a. The information provided to the claimant includes:
      1) A time deadline for requesting re-examination equal to seven days after notification of denial or partial denial
      2) Address and name of the person to whom it should be directed
      3) General information helpful in making a determination
4. The Board can waive the time deadline.

G. Cooperate with the UDOT Claims Re-examination Board in resolving disputes regarding denials or partial denials from an insurance carrier.

1. Provide any information possessed by the carrier that the Board believes is pertinent to the determination.
2. The Board may refer to an insurance carrier's decision and the reason for it.
3. The determination is based on general applicable standards of insurance adjusting.
4. The Board does not grant in-person hearings, but relies on documentation prepared by the Contractor, the insurance carrier, the claimant, and the Department.
5. Neither the insurance carrier nor the Contractor has the right to intervene in a re-examination before the Board.
6. The board decides the claim as expeditiously as possible.
7. The decision by the UDOT Claims Re-examinations Board is administratively final.

H. The Department deducts from the Contractor's pay estimate, claims that the Contractor's liability insurance carrier denied but are directed to be paid by the UDOT Claims Re-Examination Board.

1.18 INSURANCE REQUIREMENTS

The Contractor may bid one of two insurance alternates for projects where the Engineer's Estimate is equal to or greater than $4,000,000 and the ability to select an alternate is provided for in the EBS file. Alternate #2 is not applicable on projects where the Engineers Estimate is less than $4,000,000.

Alternate #1:
Provide insurance per the requirements listed in this section. Include cost for such insurance in the Contractor's bid prices. Enter $1.00 in the unit price field for the Contactor supplied insurance bid item when this alternate is provided for in the EBS file.

A. Workers' Compensation Insurance
   1. Provide Workers' Compensation Insurance to cover full liability. As a minimum, comply with the statutory limits defined by the State of Utah.

B. General Liability Insurance
   1. Provide General Liability insurance with the following minimum limits of liability:
      a. $1,000,000 Bodily Injury and Property Damage – Each Accident
      b. $2,000,000 General Aggregate
      c. $2,000,000 Products and Complete Operations Annual Aggregate

C. Automobile Liability Insurance
   1. 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:
      a. $1,000,000 Combined single Limit Bodily Injury and Property Damage per Occurrence

D. Provide the following for all required liability insurance policies:
   1. Where and when applicable, name as insured, only in respect to work to be performed under this contract, 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.
   2. Coverage for the above insured is primary and not contributing.
   3. 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."

E. Provide the Department with certificates of insurance showing that they are covered as required above before entering the project site or beginning project work. The certificates will also state that the policies required are endorsed to give the Department Engineer not less than 30 days prior notice in the event of cancellation or change in coverage. 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 object. The Department may cancel this contract immediately or sue for an injunction or any other legal remedy to require the Contractor to keep its current coverage if the Contractor cancels coverage or changes coverage despite that objection.

F. 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.

G. Endorse all policies to include waivers of subrogation in favor of the Department.

H. The Engineer gives the Contractor written notice that the certificates need to be modified so as to give the Department the required endorsements if the Department discovers that the Contractor's policies are not endorsed to the Department.
   1. Complete within 10 calendar days.
   2. Provide new certificates to the Engineer at that time.
   3. The Department may terminate the Contractor for Default as defined in Section 00555 if certificates are not obtained.

Alternate #2
The Contractor may elect to participate in the UDOT Owner Controlled Insurance Program (OCIP). Insurance will be furnished at no cost to the Contractor if the Contractor selects the OCIP Alternate. Contractors that select the OCIP Alternate must calculate 3 percent of the total bid price and enter that amount into their bid by inserting the 3 percent amount into the unit price field for the OCIP Alternate insurance bid item for bid comparison purposes. Failure to do so will result in the bid being declared non-responsive.

A. OCIP Alternate: Refer to UDOT Owner Controlled Insurance Program (OCIP) General Conditions for coverage limits and conditions on the UDOT website. Refer to: http://www.udot.utah.gov/go/standardsreferences.

1.19 SITE OF WORK

A. Refer to definition in Section 00570.

1.20 HAULING BY TRUCK

A. Comply with all Federal and State regulations regarding hauling.

B. A subcontract must be in the project office before the additional trucks needed for hauling on site only begin work on a Federal or State funded project. Hauling to the project site or away from the project site does not require a subcontract to be approved by the Engineer.

C. A subcontract approved by the UDOT Engineer is required when using additional trucks to fulfill the DBE goal.

1.21 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
150 North 1950 West
PO Box 144820
Salt Lake City, UT 84114-4810
Phone: (801) 536-4000
Fax: (801) 536-4099

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

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01280

MEASUREMENT

PART 1 GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 QUANTITY MEASUREMENT

A. All work completed under the contract is measured in U. S. standard measure.
   1. The Department measures and determines quantities of material furnished and work performed in accordance with the measurement and payment section of the contract.
   2. The methods of measurement and computations for determining quantities of material furnished and of work performed under the contract are methods generally recognized as conforming to good engineering practice.

B. When the term “plan quantity” is indicated in the contract bid item designation:
   1. Accept the estimated quantity in the bid proposal as the final quantity for which payment will be made, unless the Engineer revises the plan dimensions through an approved change order.
      a. The Engineer adjusts the final quantity for payment by the amount of increase or decrease to the estimated quantity in the bid proposal represented by authorized changes in dimensions.
   2. Request an adjustment to the final quantity for payment if an error is discovered in the estimated quantity in the bid proposal.
      a. Provide all computations, plots, and supporting documentation necessary for the Engineer to verify the error and determine the final quantity for payment.

b. All work associated with providing computations, plots, and supporting documentation is at no cost to the Department, except:

1) Work required to provide computations, plots, and supporting documentation may be paid for as extra work when the final quantity differs from the estimated quantity by more than 10 percent.

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 bid proposal to be measured by lump sum or each to include all necessary work, fittings, and accessories for a complete unit or system.

D. Length:

1. Items measured by the foot such as pipe culverts, guardrail, underdrains, etc. are measured parallel with the base or foundations upon which the structures are placed.
2. The term “station” when used as a definition or term of measurement is 100 linear feet.

E. Area:

1. The Department uses horizontal longitudinal and plan (neat) transverse measurements unless otherwise specified.

F. Volume:

1. The Department measures structures 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 of excavation.
3. Materials specified to be measured by the cubic yard may be weighed and converted to cubic yard for payment purposes, when requested by the Contractor and approved by the Engineer in writing.
   a. Agree to the factors for conversion from weight measurement to volume as determined by the Engineer before using this method of measurement for computing pay quantities.

G. Weight:

1. The term “ton” means 2000 pounds avoirdupois.
2. Measure aggregate weight in the saturated surface dry condition.

H. Standard manufactured items such as fence, wire, plates, rolled shapes, pipe conduit, etc., identified by gauge, unit, weight, section dimensions, etc.
   1. The Department uses nominal weights or dimensions and industry-manufacturing tolerances unless otherwise specified.

I. Plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing:
   1. The Department measures thickness in fractions of inches.

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 which meet specification requirements.
   1. Obtain certified haul truck tares at times as directed by the Engineer and place a legible identification mark on each truck.
   2. The Department may return any loads of material that appear to be deficient or questionable to be reweighed.

B. Furnish, erect, have certified, 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, meeting 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 the platform level and with rigid bulkheads at each end.
      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.

C. Include costs for furnishing, installing, certifying or testing, and maintaining scales, furnishing scale house, materials for proportioning or payment, and all other items specified in this section for the weighing of highway and bridge construction materials in the unit contract prices for the various pay items of the contract.

D. Request written approval to use alternate weighing devices.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01282

PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00570: Definitions

C. Section 00725: Scope of Work

D. Section 00727: Control of Work

E. Section 01284: Prompt Payment

1.3 REFERENCES

A. *Rental Rate Blue Book for Construction Equipment*

B. Wall Street Journal

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 SCOPE OF PAYMENT

A. The Department fully compensates the Contractor as provided in the contract for:
   1. Furnishing all materials, labor, equipment, tools, transportation, and incidentals required for acceptable completion of the work.

B. Lump sum or each:
   1. Consider payment as full compensation for all resources and incidentals necessary to complete the work.

C. 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 work.
   3. Loss of anticipated profits.

D. Partial payment or releasing of retainage does not relieve the Contractor of the obligation to correct all defective work or materials.

1.7 ELIMINATED ITEMS

A. Accept the Engineer's authority to eliminate contract items found to be unnecessary to complete the work.

B. Request reimbursement for all costs incurred before notification of elimination.

1.8 VARIATION IN QUANTITIES AND SIGNIFICANT CHANGES IN CHARACTER OF WORK

A. The Department pays the original contract unit prices for the accepted quantities of work or provides adjustment when the accepted quantities of work vary from the estimated quantities in the contract. Refer to Section 00725.

1. The Department does not allow compensation for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense and subsequent loss of expected reimbursement or from any other cause.

1.9 DIFFERING SITE CONDITIONS, CHANGES, AND EXTRA WORK

A. The Department pays for differing site conditions, changes, and extra work at either unit price or lump sum as stipulated in the order authorizing the work.

B. 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.

C. Negotiated lump sum or unit pricing for changes to the contract work will be based on the Contractor's estimate to do the work as validated by the Engineer's review or independent cost estimate.

1. Support the price with a detailed cost estimate. Include the following in the estimate:
   a. Labor and equipment hours based on agreed upon productivity rates.
   b. Use the actual cost of wages, benefits, burdens, and other labor related expenses for the labor rates applied to the estimated man-hours.
      1) Include certified accounting records verifying these costs or make them available upon request of the Engineer.
   c. Materials will be reimbursed at actual cost as determined by supplier invoices or estimates.
      1) Materials produced on site, such as granular borrow or UTBC will be reimbursed according to the labor and equipment rates used to produce such materials.
   d. Use the actual cost of the equipment to the Contractor for equipment rates applied to the estimated equipment hours.
      1) Include certified accounting records verifying these costs or make them available upon request of the Engineer.
2. A markup of 15 percent will be paid on all expenses identified above. This markup compensates the Contractor for home office overheads, profit, and incidental costs.
3. No other expenses will be compensated unless approved by the Engineer.

1.10 COMPENSATION FOR EXCUSABLE DELAYS

A. Document all costs claimed that result directly from a delay caused by the Department. Refer to Section 00555.

1. Use actual records kept in the usual course of business and measure increased ownership expenses according to generally accepted accounting principles.
   a. Do not use equipment rental rate guides.
2. The Department does not compensate for the following:
   a. Profit more than provided in accordance with this section
   b. Loss of profit
   c. Labor inefficiencies
   d. Home office overhead exceeding that provided
   e. Consequential damages, including, but not limited to, loss of bonding capacity, loss of bidding opportunities, and insolvency
   f. Any indirect costs or expenses

g. Attorney's fees, claims preparation expenses, or litigation costs

B. Compensable costs will be determined as follows:

1. **Direct Costs:** Actual costs of the Contractor's workforce and equipment idled by the delayed activity.
   a. Provide an accountant's certification of all costs.
2. **Field Indirect Costs:** Actual costs 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.
   a. Provide an accountant's certification of all costs.
3. **Home Office Overhead:** Unabsorbed home office costs that would have been paid for by the project billings if the work had not been delayed. To be entitled to home office overhead costs, demonstrate the delay-causing event resulted in financial harm.
   a. No unabsorbed home office overheads will be reimbursed for the first five calendar days of the delay-causing event.
   b. Calculate home office overhead cost from the sixth calendar day of the delay-causing event through its end if the project is between 0 and 95 percent complete.
   c. Use the following formula to calculate home office overhead costs:

$$E = D\,[0.05(A)/C]$$

Where:

0.05	=	Allowed markup for home office overhead
A	=	Current contract value
C	=	Total contract duration in calendar days, including approved time extensions
D	=	Number of calendar days the critical path of the schedule is delayed due to the delay-causing event minus five.
E	=	Total reimbursable amount for unabsorbed home office overhead

   d. No home office overheads will be reimbursed if the delay occurs after the project is 95 percent complete.

C. The total reimbursable cost for a compensable delay is the sum of the daily agreed to costs for direct costs, field indirect costs, and unabsorbed home office overhead costs as computed in accordance with this article for the duration of the delay. No other costs, including profit, will be reimbursed.

1.11 FORCE ACCOUNT

A. The Engineer may require the Contractor to work on a force account basis when the Contractor and Engineer are unable to negotiate an agreed upon price for changed or added work.
   1. Costs reimbursed in accordance with this section are considered full and complete compensation for:
      a. All field indirect costs, including project management and supervision, field office operating costs, and all field office staff, except for time spent in immediate and direct supervision of the force account work.
      b. All home office overhead costs and other indirect costs incurred as a result of the force account work.
   2. The Department does not compensate for small tools costing $200 or less or any other costs for which no specific allowance is provided in this section.

B. Compensation for labor:
   1. The Department pays straight time for all hours worked. Overtime must have the prior written approval of the Engineer.
   2. The Department pays for all labor, including direct supervision used in the actual and direct performance of the work at the wage or scale agreed upon in writing before beginning work.
   3. The Department reimburses for actual costs paid to or in behalf of workers, including health and welfare required by collective bargaining agreements or other employment contract generally applicable to the classes of labor employed on the work.
   4. The Department pays Contractor an amount equal to 60 percent of the sum of the above items to cover the costs of bonds, insurance, taxes, and all other indirect costs in addition to the above costs.
      a. Submit wage, payroll, and cost records pertaining to work paid for on a force account basis to the Engineer. This information is open to inspection or audit.
   5. The Department reimburses for actual costs for subsistence and travel allowance.

C. Compensation for materials:
   1. The Department pays for all materials accepted by the Engineer and incorporated in the project at actual cost, including sales taxes and transportation charges plus 15 percent.
      a. Materials such as saw blades, drill bits, etc., expended in the course of performing the work, excluding equipment, are considered incorporated in the project.

b. Include invoices with statements for all materials used. Certify by affidavit the cost of material furnished from Contractor's stocks when no invoice is available.

D. Compensation for equipment:

1. The Department does not pay for pickup trucks used solely for transportation.
2. The Department pays for machinery or special equipment, excluding small tools, authorized by the Engineer at an hourly rate obtained from the *Rental Rate Blue Book for Construction Equipment*. These hourly rental rates are determined by the monthly rental rate taken from the above-mentioned publication divided by 176. 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.

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

   a. Operating Rate - For those hours the equipment is actually in use.
      1) 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. This rate is 50 percent of the adjusted ownership and operating costs computed above.
      1) The duration of allowable standby time is to be approved in writing by the Engineer with a maximum of eight hours per day or 40 hours in a week.
3. The Department uses the shown capacity that is closest to the manufacturer's when the Manufacturer's Rated Capacity falls between those shown in the *Rental Rate Blue Book for Construction Equipment*.
4. Agree upon all rates in writing before beginning work.
5. Obtain approval from the Engineer for any equipment rental rates not provided before the start of any force account work.

6. The Department allows move-in and move-out transportation cost for a piece of equipment not available on the job, 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.
7. The Department adds a 10 percent allowance on the first $5,000 plus five percent of the balance in excess of $5,000 for overhead for all rented or leased equipment paid for by invoices when the equipment used is specialized and not available in the Contractor's inventory and is rented or leased from an outside source.
    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. The Department pays equipment-operating costs at the rate from the *Rental Rate Blue Book for Construction Equipment* for rented or leased equipment for each hour the equipment was actually used.
8. The equipment may be rented from a local source when the required equipment is in the Contractor's available inventory but not on the project site. The Engineer may approve rental rates for equipment obtained from local sources when such rates are within 10 percent of the *Rental Rate Blue Book for Construction Equipment*. Move-in and move-out costs for Contractor owned equipment may be considered when comparing rental costs of equipment obtained from local sources when the equipment is to be used less than a week.
    a. This option is only allowed when the cost of locally rented equipment is less than using Contractor owned equipment including move-in and move-out charges.
    b. Such rentals must be supported by a cost analysis indicating the method used was the least expensive.
    c. The Department reimburses for such equipment based on the *Rental Rate Blue Book for Construction Equipment* if the Contractor elects to rent equipment of a type that is in the Contractor's inventory and the rental costs exceed that allowed by this article.

E. Subcontracts:
1. The Department pays an additional allowance equal to six percent for overhead for the subcontract for all force account work performed under an approved subcontract.

2. The Engineer reviews each situation to determine that performing the work by subcontract is justified.

F. Compare cost records daily with the Engineer.

G. Provide an itemized statement of the cost of the force account work at the Engineer's request including:
   1. Name, classification, date, daily hours designating straight time and overtime, total hours, rate, and extension for each laborer and supervisor. Payrolls may be used for some of this information.
   2. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
   3. Quantities of materials, prices, and extensions.
   4. Transportation of materials and equipment.
   5. Cost of fringe benefits and subsistence.
   6. Subcontractors.

1.12 PROGRESS PAYMENTS

A. The Department makes progress payments at least once each month as the work is progressing.

B. More frequent payments may be made during any period when the Department determines that the value of work performed during the period is sufficient to warrant a payment.

C. Payments are based on estimates prepared by the Engineer of the value of the work performed and materials in place under the contract and for payment for material on hand in accordance with this section.

D. The Department does not make any progress payment when the total value of the work done since the last estimate is less than $1,000.

E. 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:
   a. Retention for subcontracted work is paid upon satisfactory completion and acceptance by the Department. Refer to Section 01284.
   b. 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. The Department certifies the remainder for payment, less all previous payments.

F. 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 and Materials.

G. 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.

1.13 PAYMENT FOR MATERIAL ON HAND

A. Present the delivery copies of invoices. The Department may include advance 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 in the partial payment invoice.
   1. 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.
   2. Furnish evidence that the stockpiled materials are irrevocably obligated to the project when the approved storage location is other than the project site.
   3. 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.
   4. Furnish the Engineer 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.
   5. 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 any partial payment on living or perishable materials until incorporated as specified in the contract.

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 final acceptance of such materials for use in completing items of work.

E. The Department purchases at actual cost and without any percentage allowance for profit, 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.

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 provided the material is stockpiled where directed and meets specification requirements when stockpiled at the option of the Department.
   1. The Department pays for material accepted on an agreed price basis, which price 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 FINAL PAYMENT

A. The Engineer prepares the final estimate of work performed when the project has been accepted in accordance with Section 00727.
   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 all previous payments and all amounts to be retained or deducted under the provisions of the contract after approval of the final estimate by the Contractor.

B. File a full, complete, and itemized written statement with the Department justifying the adjustment within 30 calendar days after the final estimate is submitted for approval if additional payment is due from the Department.
   1. Contractor waives all 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. All 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.

1.15 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 at any time during the contract by written notification to the Engineer.
      a. Adjustments are then made on all prior and future partial estimates.
      b. This provision becomes effective when it 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 posted in the commodities and futures section of the Wall Street Journal. 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 in accordance with this article.

C. Determining FCA:
1. FCA only applies to acceptable work performed on major contract items, as defined in Section 00570, and eligible items in Table 1 with an individual value of more than $100,000, or as otherwise specified in Table 1, based on original contract quantities.
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 and approved time extensions, 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 in writing 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 Borrow, Top Soil	Cubic Yard Ton	0.45 0.25
Underdrain Granular Backfill	Cubic Yard	1.16
Untreated Base Course	Ton Cubic Yard	0.84 1.63
Hot Mix Asphalt	Ton Cubic Yard	3.60 7.00
Open Graded Surface Course	Ton Cubic Yard	3.60 6.80
Stone Matrix Asphalt (SMA)	Ton Cubic Yard	3.60 6.80
Rotomilling Profile Rotomilling In-Place Cold Recycled Asphaltic Base Recycled Surface	Sq Yd Sq Yd Sq Yd Sq Yd	0.03
Chip Seal Coat	Square Yard	0.03
Portland Cement Concrete Pavement Lean Concrete Base Course	Sq Yd-In Sq Yd-In	0.214 0.048
Riprap	Cubic Yard	0.57
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

1.16 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 may invoke this provision at any time during the contract by written notification to the Engineer.
      a. Adjustments are then made on all future partial estimates.
      b. This provision becomes effective when it remains in effect for the duration of the contract.

B. The Department adjusts the price of asphalt materials for acceptable work performed on bid 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. The Department determines the EPa on the first Monday of each month using the spot price per barrel for West Texas Sour (WTS) crude oil posted in the commodities and futures section of the Wall Street Journal. This spot price is averaged with spot prices posted for the previous three Mondays to establish the EPa.
      b. 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 (BPa): The contract base asphalt price, equal to the EPa in effect on the date of the contract bid opening.
   3. Asphalt Cost Adjustment (ACA): The asphalt cost adjustment in dollars determined in accordance with this article.

D. Determining ACA:
   1. ACA does not apply to any work performed within 120 calendar days of the contract bid opening date.
   2. ACA does not apply to work added by change order.
   3. ACA may be positive or negative depending on the changes or differences between the BPa and the EPa.
   4. For work performed after the expiration of contract time and approved time extensions, the EPa will be limited to the lesser of:
      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. ACA Formula:

When the EPa is more than 15 percent above the BPa:

$$ACA = [(EPa - BPa) - 0.05\ BPa]\ (5.6)\ T$$

When the EPa is more than 15 percent below the BPa:

$$ACA = [(EPa - BPa) + 0.05\ BPa]\ (5.6)\ T$$

Where:

T	=	Tons of asphalt used
5.6	=	Conversion of barrels of crude oil per ton of asphalt

The Engineer determines T as follows:

1. For PG asphalt binders
   a. Use the target percentage of asphalt binder in the approved mix design for the quantity of accepted material for:
      1) Hot Mix Asphalt (HMA)
      2) Stone Matrix Asphalt (SMA)
   b. Use the quantity of accepted asphalt binder for:
      1) Open-Graded Surface Course (OGSC)
2. Use the residual asphalt calculated from the quantity of accepted material for Emulsified Asphalts.
3. Use the quantity of accepted material for Cutback Asphalts.

F. The Department determines the feasibility of proceeding with the remainder of the project and notifies the Contractor in writing if the project is to be terminated if the EPa increases by more than 50 percent from the BPa for an eligible item of work.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01284

PROMPT PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section applies to all Contracts.

B. Requirements applicable to Contractors, subcontractors, service providers, material suppliers, and all tier subcontractors, service providers, and suppliers.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PROGRESS PAYMENTS

A. Include in subcontract, service, or purchase agreement language agreeing to pay promptly as required by this specification.

B. Pay subcontractors for satisfactory performance of sublet work, no later than 10 working days after receipt of payment by the Department.
   1. Enter all subcontractor payments into PDBS Subcontractor Payment Screen within 10 days of receipt of payment by the Department. Date entered should reflect actual date payment was sent to subcontractor.
   2. Entry of payments into PDBS will serve as the Prompt Payment Affidavit. Actual date of entry is tied to the date the pay estimate is sent to the Comptroller. If the entry date exceeds 15 days from the Comptroller date the entry will flag red, indicating non-compliance with the Prompt Payment Provision.

C. Pay Material Suppliers and Service Suppliers within 30 calendar days after receipt of payment for work that includes materials and or services.

1.7 RETAINED MONEY

A. Include in subcontract, service, or purchase agreement language agreeing to pay retained money for subcontract, service, or purchase agreement upon satisfactory completion of the work and acceptance by the Department.

B. Subcontract work is considered satisfactorily completed for purposes of this Section when all work included in the subcontract is complete in accordance with all requirements of the contract and documented as required by the recipient. Partial work is considered to be satisfactorily completed when a recipient accepts that portion of the work.

C. Require written notification from the subcontractor when all subcontract items are complete.
   1. Notify the Engineer in writing within two working days after written notification from the subcontractor.
   2. The Engineer schedules and coordinates an inspection for acceptance of the work within three working days.
   3. Receive notification from the Department in writing when the work is considered to be satisfactorily complete and accepted. Acceptance of the work includes all requirements of the contract and agreement on pay quantities.
   4. The Department releases an amount equal to the subcontractor's retainage upon acceptance of the work. Submit to the Engineer a certified statement:
      a. In the form of an affidavit on letterhead, including the signature of a legally responsible official, and the signature of a legally responsible official for the subcontractor, certifying that the total amount due is the total retention.

D. Pay retained money owed to the subcontractor for satisfactory completion of the accepted work no later than 30 calendar days after receipt of payment from the Department.

E. A determination of satisfactory completion and payment of retained money does not relieve any contractual obligation.

1.8 PAYMENT DELAY

A. Delay payment only for cause and document the reason in the comments portion of subcontractor payment screen. This will serve as notification to the project office.
   1. Send written notification to the subcontractor.

B. Provide subcontractor 10 working days from date of written notification to correct deficiencies.
   1. Release payment upon receipt of documentation demonstrating correction of deficiencies within 10 working days.

C. Engineer may withhold dollar amount of delayed payment from future estimates.

D. Include in subcontract, service, and purchase agreements, language providing for the use of appropriate alternative dispute resolution mechanisms to resolve time of payment disputes.

E. Department may hold disputed funds in escrow until the dispute is resolved.

1.9 LIQUIDATED DAMAGES

A. The Engineer will provide written notification to the Contractor upon determination by the Department of failure to make prompt payment. Resolve the failure and make prompt payment within three working days.

B. Failure to resolve prompt payment results in the assessment of $250 per each working day, per violation, commencing from the date of the written notification until proof of payment is received.

C. Proof of payment is defined as providing confirmation from the subcontractor that payment has been received.

D. Department considers the failure to make prompt payment an indication of a lack of financial fitness. The following additional measures may be imposed as necessary:
   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, supply or purchase agreement approved to perform work or supply materials on Department projects until payment covered by this Section is made.

E. Department employs other mechanisms consistent with this Section and applicable state and local law so payment is fully and promptly made.

1.10 CONTRACTOR INCENTIVE ENTITLEMENT

A. The Prime Contractor will be paid $250 to for each subcontractor provided the following criteria is met:
   1. Subcontractor worked on the project.

2. All prompt payment statements submitted to the project office within five working days after payment to subcontractors.
3. Department received no valid complaints regarding prompt payment.
4. Payment was made within 30 days after project reached physical completion.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END SECTION

SECTION 01285

MOBILIZATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparatory work and operations necessary for moving personnel, equipment, supplies, and incidentals to the project site before beginning work.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PAYMENT PROCEDURES

A. Refer to Measurement and Payment document.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01315

PUBLIC INFORMATION SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 00555: Prosecution and Progress

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 PERFORMANCE REQUIREMENT

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

1.7 PUBLIC INFORMATION COORDINATOR (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 hours 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 inquires 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 Public Involvement Coordinator 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 prior to 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 Public Involvement Coordinator for review prior to 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 prior to 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 inquires, written and verbal, regarding the project or project activities to the Region Public Involvement Manager or the UDOT Communications Office.

END OF SECTION

SECTION 01355

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Comply with all Federal, State, local laws and regulations, and provisions of this Section.

B. Prevent pollution of streams, lakes, ponds, and reservoirs with sediment, fuels, oils, bitumens, chemicals, or other harmful materials and pollution of the atmosphere from particulate and gaseous matter.

C. Use Best Management Practices to prevent hazardous material releases by segregating wastes, providing secondary containment and having spill kits and absorbents on hand.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ANSI

B. Title 40, Code of Federal Regulations (CFR)

C. U. S. Environmental Protection Agency Regulations

D. Utah Administrative Code

E. Utah State Department of Environmental Quality Regulations

1.4 DEFINITIONS

A. Receptor - An occupied residential dwelling, church, hospital, school, outdoor stage, or structure confining other noise sensitive activities.

B. Noise Sensitive Zone - The land enclosed within a 1500-ft radius circle of any receptor.

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

D. Percussive Noise - Short bursts of banging or clattering noise including but not limited to blasting, pile driving, and jack-hammering.

1.5 SUBMITTALS Not Used

1.6 HAZARDOUS MATERIAL DISCOVERED DURING CONSTRUCTION

A. Immediately suspend work in the area and if abnormal conditions are encountered or exposed during construction that indicates the presence of a hazardous material, toxic or hazardous waste.
   1. Treat the conditions with extreme caution.
   2. Abnormal conditions include, but are not limited to, the following: presence of barrels, buried storage tanks, above ground tanks, obnoxious odors, excessively hot earth, stained and discolored soils, smoke, unidentifiable powders, sludges, pellets, or any other condition that can be a possible indicator of hazardous material and toxic or hazardous waste.

B. Execute the following notifications if hazardous waste is discovered that meets 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.
   1. Notify the Engineer immediately after the discovery.
   2. Notify the Utah Department of Environmental Quality (DEQ) according to R315.9 of Utah Administrative Rules. 24-hour phone number: (801) 536-4123.
   3. Notify the DEQ in writing within five calendar days of the discovery.

C. Contact the Engineer to initiate development of a remediation plan according to Utah State Department of Environmental Quality and the United States Environmental Protection Agency (EPA) regulations and requirements.

D. Dispose of hazardous material, toxic or hazardous waste under the direction of the Engineer, according to the remediation plan, and requirements and regulations of the Utah State Department of Environmental Quality and the United States Environmental Protection Agency.

E. Resume operation in the affected area when directed by the Engineer. Continue working in other areas of the project, unless otherwise directed by the Engineer.
   1. Perform necessary work required to dispose of these materials as extra work.

2. Disposition of waste materials requiring special procedures by certified personnel will be arranged by the Department with qualified persons to dispose of the material.

1.7 HAZARDOUS MATERIAL – CONTRACTOR CAUSED

A. Execute the following notifications if a petroleum-based or hazardous waste spill occurs that meets 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 the Electronic Code of Federal Regulations Web site.
   1. Notify the Engineer immediately after the discovery of any spill defined as a reportable release which includes spills that are:
      a. greater than 25 gallons
      b. released to a water body.
   2. Notify the Utah Department of Environmental Quality (DEQ) according to R315.9 of Utah Administrative Rules. 24-hour phone number: (801) 536-4123.
   3. Notify the DEQ in writing within five calendar days of the discovery.

B. In the event of a petroleum or chemical spill:
   1. Immediately respond to a spill <25 gallons with spill kits.
   2. For spills >25 gallons, implement measures to minimize the spread of contaminants.

C. Capture and dispose of the spilled materials under the direction of the Engineer according to the requirements of the State of Utah Department of Environmental Quality and the United States Environmental Protection Agency.

D. Document the spill and response action and submit a copy to the Engineer.

E. Pay for all required clean-up operations.

1.8 STREAMS

A. Any work in or adjacent to a perennial or ephemeral stream or river requires a General Permit 40 (stream alteration permit) issued by the Utah Department of Water Rights, Utah Administrative Code: Rule R655-13 Stream Alteration.
   1. Adhere to the General and Special Conditions associated with the permit.
   2. Conform to stream disturbance limits identified in the plans.

B. Obtain approval from the Utah Division of Water Rights before proceeding if a stream alteration permit is not issued for the project and work needs to be done in or adjacent to a stream. Notify the Utah Division of Water Quality if construction activity increases water turbidity in the stream by 10 NTUs or more. Use a dike or barrier to separate temporary work areas located in streams from the main stream when working in a live stream. Minimize sediment from entering streams.

C. Use filtration, settling basins, or other methods to treat sediment-laden water before allowing it to enter a water body.

1.9 OPEN BURNING

A. Do not conduct open burning along highway rights-of-way without approval orders from the Executive Secretary of the Utah Division of Air Quality.

1.10 ABRASIVE BLASTING – VISIBLE EMISSION STANDARDS

A. **Visible Emission Standards:**

1. Abrasive blasting outside of Weber, Davis, Salt Lake and Utah Counties: Do not discharge into the atmosphere opacity darker than 40 percent for a period or periods aggregating more than three minutes in any one hour.
2. Abrasive blasting inside Weber, Davis, Salt Lake or Utah Counties where the performance standards in this article, paragraph C are used: Do not discharge into the atmosphere opacity darker than 20 percent for a period or periods aggregating more than three minutes in any one hour.
3. Abrasive blasting inside Weber, Davis, Salt Lake or Utah Counties where the performance standards in this article, paragraph C are not used: Do not discharge into the atmosphere opacity darker than 40 percent for a period or periods aggregating more than three minutes in any one hour.

B. **Visible Emission Evaluation Techniques:**

1. Read emissions from unconfined blasting at the densest point of the emission after a major portion of the spent abrasive has fallen out. Densest point will be between 6 ft and 25 ft from the impact surface of the abrasive blasting nozzle.
2. Judge emissions from unconfined blasting employing multiple nozzles as a single source unless each nozzle meets the emission and performance standards.
3. Read emissions from confined blasting at the densest point after the air contaminant leaves the enclosure.

C. **Performance Standards:** Any one of the following may be used as a performance standard.
   1. Confined blasting
   2. Wet abrasive blasting
   3. Hydroblasting
   4. Unconfined blasting using abrasives defined below:
      a. Before blasting, the abrasive will not contain more than one percent by weight material passing a #70 U.S. standard sieve.
      b. After blasting, the abrasive will not contain more than 1.8 percent by weight material 5 micron or smaller.
      c. Abrasives reused for dry unconfined blasting are exempt from the requirements of "after blasting," but must conform to the requirements of "before blasting" above.

D. **Abrasive Certification:** Sources using the performance standard for unconfined blasting must demonstrate they have obtained abrasives from people who have certified through submitted test results to the Utah Air Quality Executive Secretary at least annually that such abrasives meet the requirements outlined above for abrasives.

1.11 NOISE CONTROL

A. Identify haul routes and percussive noise sources that annoy sensitive receptors and prevent these sources from becoming a problem.

B. Prohibitions - Suspend construction work under the following conditions:
   1. Construction activity in a noise sensitive zone causes the sound level within 10 ft of the nearest receptor to exceed: 95 dBA in daytime (7 a.m. - 9 p.m.), or 55 dBA in nighttime (9 p.m. - 7 a.m.)
   2. A noise sensitive zone on Sundays and State Holidays.
   3. Project related construction noise does not meet specifications. Suspend the portion of construction work responsible for the problem until noise is reduced to the required noise standards.

C. Compliance:
   1. Follow all local noise ordinances, except where a variance according to local regulations has been granted.
   2. Local noise ordinance variance does not provide an exemption from complying with the requirements of this article, paragraph C.

D. Percussive Noise:
   1. Notify the Engineer at least two weeks in advance of any percussive noise activity that is expected to exceed the provisions of this article, paragraph C.
   2. Coordinate notification of the public with the Engineer.

1.12 ENVIRONMENTAL CLEARANCE BY THE CONTRACTOR

A. Obtain and provide the following environmental clearances before beginning project activity when adding or selecting any ground- or resource-disturbing features such as material such as gravel, borrow or waste sites, equipment staging sites, office sites, water lines, holding ponds, etc., not provided in the Contract:

1. Cultural and Paleontological - Initiate consultation concerning proposed additional features with a Department staff archeologist. Hiring a private archeological sub consultant and coordination with the Utah State Historic Preservation Office may be required.
   a) The Department staff archeologist provides clearance to the Contractor via written notification. Refer to this Section, article 1.13.
2. Threatened or Endangered Species: Obtain written clearance from the U.S. Fish and Wildlife Service.
3. Wildlife Resources: Obtain written clearance from the State Division of Wildlife Resources.
4. Wetlands: Obtain written clearance from the U.S. Army Corps of Engineers.
5. Floodplains - Initiate consultation concerning the proposed additional features with the Region environmental staff.
   a) Subsequent coordination with the Federal Emergency Management Agency (FEMA) may be required.
   b) The Region Hydraulic Engineer provides verification of non-interference by the Contractor with a floodplain or compliance with FEMA guidelines to the Contractor.
6. Prime, Unique, and Important Farmland - Initiate consultation concerning the proposed additional features with the farmland specialist with the Region's Environmental Engineer.
   a) Subsequent coordination by the Contractor with the U.S. Natural Resources conservation service may be required.
   b) The Region provides written clearance to the Contractor.
7. Utah Pollutant Discharge Elimination System (UPDES) - Obtain UPDES permit for storm water discharge from Utah Division of Water Quality (DWQ).
   a) Comply with the requirements of the permit including submittal of Notice of Intent (NOI) form to DWQ and development and approval of the storm water pollution prevention plan by the DWQ when required.
8. Air Quality: Obtain construction approval from the Utah Division of Air Quality if construction project or area of disturbance outside of the project is in an area of air quality non-attainment for any pollutant.

B. Contractor is responsible for all costs of pursuing and obtaining all the above clearances, and is not entitled to time extension for delays encountered in obtaining these clearances.

1.13 DISCOVERY OF HISTORICAL, ARCHAEOLOGICAL, OR PALEONTOLOGICAL OBJECTS, FEATURES, SITES, HUMAN REMAINS, OR MIGRATORY AVIAN SPECIES

A. Immediately suspend construction operations in the vicinity (minimum 100-ft buffer around the perimeter) of the discovery if a suspected historic, archaeological, or paleontological item, feature, or site is encountered, or if suspected human remains are encountered.

B. Verbally notify the Engineer of the nature and exact location of the findings.

C. The Engineer contacts the UDOT Region staff archaeologist, who will assess the nature of the discovery and determine the necessary course of action.

D. Notify the Engineer who in turn notifies the Region Environmental Manager and the UDOT Wildlife Biologist if bats or migratory birds are discovered on structures.
   1. Coordinate to determine the necessary course of action.

E. Protect the discovered objects or features and provide written confirmation of the discovery to the Engineer within two calendar days.

F. The Engineer keeps the Contractor informed concerning the status of the restriction.
   1. The time necessary for the Department to handle the discovered item, feature, or site is variable, dependent on the nature and condition of the discovered item.
   2. The Engineer will provide written confirmation when work may resume in the area.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01452

PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Process and procedures for acceptance testing and determination of Incentive/Disincentive for smoothness of Hot Mix Asphalt (HMA), Open Graded Surface Course (OGSC), Stone Matrix Asphalt (SMA), and Portland Cement Concrete Pavement (PCCP) using a California type profilograph or profiler, approved and certified by the Department.

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

1.6 GENERAL REQUIREMENTS

A. Pavement smoothness is determined through Department inspection of Contractor testing using a California type profilograph or profiler, approved and certified by the Department.
   1. Certify operators and equipment through the Department.
   2. Engineer verifies certifications.

B. Comply with project Traffic Control Plan and all applicable safety requirements when performing testing.

1.7 ACCEPTANCE

A. Notify the Engineer in writing after all corrective work has been performed at least two working days before scheduling Department inspection of acceptance testing on the final pavement surface.
   1. Clearly define the areas to be tested for acceptance in the written notification.
   2. Do not perform any work on the final surface after acceptance testing, except as directed by the Engineer.

B. The Department evaluates the surface by section for purposes of determining incentive/disincentive as defined:

1. Class I surface, 0.1 mile in length, including the adjacent shoulder. Refer to Table 1 for definition of Class I surfaces. Begin the initial section at the start of the project. Lay out subsequent sections consecutively to the end of the project.
   a. Testing consists of a single trace measurement of each wheel path, defined as a continuous parallel line 2.5 ft inside the projected lane or median lines.
   b. Testing of adjacent shoulders having a design width of 6 ft or greater consists of a single trace measurement, approximately centered in the shoulder.
   c. Determine the Profile Index (PI) by taking the average of all profile traces taken on the section.
      1) Include profile trace deviations from manholes, valves, and other facilities in the profile trace when the contract requires the adjustment or reconstruction of these facilities.
      2) Exclude profile trace deviations from manholes, valves, and other facilities in the profile trace when the contract does not include adjustment or reconstruction of these facilities.
      3) Do not measure PI for shoulders having a design width less than 6 ft

C. The Department evaluates longitudinal and transverse deviations for both Class I and Class II surfaces. Refer this Section, article 3.1 for construction requirements.

D. The Department evaluates all roadway sections paved through the final lift and evaluates the remaining final lift of pavement upon completion.

1.8 MEASUREMENT AND PAYMENT PROCEDURE

A. All work necessary to prepare the pavement for testing, such as but not limited to sweeping, is incidental to the work and is not measured for payment.

1. Include all costs and resources for smoothness testing, preparation and correction in the surfacing bid items.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 HMA, SMA, AND OGSC

A. Construction Requirements
   1. Construct finished pavement to meet the surface requirements in Table 1.
   2. Identify defects exceeding the limits in Table 1 and correct before acceptance testing.
      a. Analyze the profile using 0.2-inch blanking band.
      b. Correct defects across the entire width of the traffic lane or shoulder either by grinding with a device approved by the Engineer, or by filling as directed by the Engineer.
      c. Re-profile for correction verification before acceptance testing.
   3. Correct transverse defects where the pavement surface varies more than ⅛ inch from the lower edge of a 10-foot straightedge placed perpendicular to the centerline of the roadway.
   4. Seal areas that have been ground with asphalt tack coat.
      a. Use a tack coat application rate between 0.07 and 0.14 gal/yd^2.
   5. The Department inspects acceptance testing before the placement of Chip Seal Coat, when applicable.

B. Acceptance Testing
   1. Perform acceptance testing in accordance with the Section article 1.7.
      a. Acceptance testing consists of PI determination for Class I surfaces and determination of compliance with allowable profile deviation for Class II surfaces.
   2. Incentive/Disincentive - HMA
      a. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.7, paragraph B.
         1) Incentive/Disincentive is calculated according to Table 2, with partial sections prorated based on length.
         2) Incentive/Disincentive does not apply to HMA surfaces on projects requiring OGSC or SMA.
         3) Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive. Disincentive remains applicable for sections where grinding exceeds 20 yd^2.

b. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.

c. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100 per day after 14 calendar days per each section needing corrective work.

1) The Engineer may waive liquidated damages when it is determined to be in the best interests of the Department to defer corrective work.

3. Incentive/Disincentive - OGSC and SMA Surfaces

a. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.7. Partial sections are prorated based on length and Incentive/Disincentive is calculated according to Table 3, with the following exception:

1) Any section requiring grinding exceeding 20 yd^2 or any section still requiring corrective work that is identified at the time of acceptance testing results in a disincentive of $1,000 per section.

b. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100 per day per each section needing corrective work.

1) The Engineer may waive liquidated damages when it is determined to be in the best interests of the Department to defer corrective work.

3.2 PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

A. Construction Requirements

1. Construct finished pavement to meet surface requirements listed in Table 1.
2. Identify defects exceeding the limits in Table 1 and correct before acceptance testing.
   a. Analyze the profile using 0.2-inch blanking band.
3. Correct defects across the entire width of the traffic lane or shoulder by grinding with a device approved by the Engineer.
   a. Re-profile for correction verification before acceptance testing.
4. Correct transverse defects where the pavement surface varies more than ⅛ inch from the lower edge of a 10-foot straightedge placed perpendicular to the centerline of the roadway.

B. Acceptance Testing

1. Perform acceptance testing in accordance with this Section, article 1.7.
    a. Acceptance testing consists of PI determination for Class I surfaces and determination of compliance with allowable profile deviation for Class II surfaces.
2. Incentive/Disincentive - PCCP
    a. Incentive/Disincentive applies only to Class I surfaces for each pavement section defined in this Section, article 1.7, paragraph B.
        1) Incentive/Disincentive is calculated according to Table 4, with partial sections prorated based on length.
    b. Any section requiring grinding exceeding 20 yd^2 does not qualify for incentive.
    c. Any section still requiring corrective work that is identified at the time of acceptance testing results in loss of incentive for the section. Disincentives remain applicable and are based on PI obtained at the time of acceptance testing.
    d. Failure to correct defects, identified at the time of acceptance testing, within 14 calendar days after notification by the Engineer results in liquidated damages assessed at $100 per day per each section needing corrective work.
        1) The Engineer may waive liquidated damages when it is determined to be in the best interests of the Department to defer corrective work.

Table 1

Surface Requirements				
Pavement Category	**Class 1 Surface**		**Class II Surface**	
	Section PI	**Profile Deviation**	**Section PI**	**Profile Deviation**
Category	**in/mi**	**in/25ft**	**in/mi**	**in/25ft**
1	5	0.3	N/A	0.3
2	7	0.3	N/A	0.3
Category 1	National Highway System and Truck Routes (See Section 02741, Table 11) and all other routes with surfaces having three or more opportunities for improving the ride. *			
Category 2	All other routes incorporating single lift overlays with not more than two opportunities for improving the ride. *			
Class I	Surfaces longer than 1,000 ft in length consisting of all traffic and climbing lanes, passing lanes, acceleration and deceleration lanes, ramps, medians wider than 8 ft, and turn lanes. Includes bridges and bridge approach slabs with final riding surfaces placed as part of the contract. Excludes horizontal curves having a centerline radius of curvature less than 900 ft and areas within the superelevation transitions to these short radius curves.			
Class II	Surfaces consisting of all tapers, road approaches, mainline pavement sections with posted regulatory speeds less than 35 MPH, pavement within 15 ft of bridge decks and approach slabs not paved as part of the contract, pavement to a point 50 ft beyond the paving limits of the project, and all other surfaces not included in the Class I definition.			

* Each opportunity to improve the ride is one of the following: Placing a gravel or treated base course, OGSC, SMA, rotomilling, cold recycling, and each lift of paving. Leveling is not considered an opportunity to improve the ride.

Table 2

HMA Incentive/Disincentive	
Category	**Incentive/Disincentive per Section**
1	$60 x [(Required in/mi) - (PI)]
2	$30 x [(Required in/mi) - (PI)]

Table 3

OGSC & SMA Incentive/Disincentive	
Category	**Incentive/Disincentive per Section**
1	$150 x [(Required in/mi) - (PI)]
2	$100 x [(Required in/mi) - (PI)]

Table 4

PCCP Incentive/Disincentive	
Category	**Incentive/Disincentive per Section**
1	$200 x [(Required in/mi) - (PI)]
2	$125 x [(Required in/mi) - (PI)]

END OF SECTION

SECTION 01455

MATERIAL QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES Not Used

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

1.3 REFERENCES

A. UDOT Materials Manual of Instruction Part 8

B. UDOT Minimum Sampling and Testing Requirements

C. U. S. Code of Federal Regulations

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 SUPPLY SOURCE AND QUALITY REQUIREMENTS

A. Use only materials that meet contract requirements.

B. Notify the Engineer in writing of the proposed source of materials to be used before their delivery.

C. Correct or remove materials that fail to meet contract requirements.

D. Use new materials for the work unless otherwise specified.

E. Pay all related costs, including those for haul distance and for exploring and developing sources.

1.7 DEPARTMENT FURNISHED MATERIALS SOURCES

A. Possible sources of local optional materials may be available.
   1. Determine the amount of equipment and work required to produce a material meeting the specifications using these sources.
   2. Expect variations in quantity and quality.

3. Material may be rejected if it is unacceptable or does not meet contract requirements.

B. Specific information about the location of possible sources is available at the Region Materials Lab.
   1. The Department does not represent that by making this information available a bidder can expect to produce materials corresponding with those previously produced by others or that the Contractor may expect to produce acceptable materials based on the interpretation of information, including any quality test information.

C. Perform required quality tests using a laboratory qualified by UDOT. Submit copies of test reports to Engineer.
   1. The Engineer may require additional samples for inspection and testing before authorizing use of the material.
   2. Obtain Engineer's written approval to use material based on Contractor's quality test results.

D. Prepare materials site plans that show in detail the line and grades to which materials are to be removed.
   1. Obtain Engineer's written approval of the materials site plans before removing any material.

E. Strip and stockpile topsoil before removing any materials.

1.8 CONTRACTOR FURNISHED MATERIALS SOURCES

A. Obtain required Environmental Clearances. Refer to Section 01355.

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

C. Locate borrow, gravel, and quarry material sites where they are not visible from the highway, when possible.

D. Perform required quality tests using a laboratory qualified by UDOT. Submit copies of test reports to Engineer.
   1. The Engineer may require additional samples for inspection and testing before authorizing use of the material.
   2. Material may be rejected if it is unacceptable or does not meet contract requirements.

E. Prepare materials site plans that show in detail the line and grades to which materials are to be removed.
   1. Obtain Engineer's approval of the materials site plans before removing any materials.

F. Strip and stockpile topsoil before removing any materials.

1.9 FINISHING MATERIAL 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 waste sites in areas that are least visible from public view. Spread waste material to obtain a natural appearance.

D. Remove trash. 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.

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 and approved by the Engineer and property owner. Perform seeding under the contract requirements for seeding and mulching.

G. Finishing local material source sites including seeding and mulching is not measured or paid for separately and is considered incidental to other items of work.

H. Provide the Engineer with a written release from the property owner indicating that all conditions of the agreement are satisfied before final acceptance.

1.10 SAMPLES, TESTS, AND REFERENCED CITED SPECIFICATIONS

A. Incorporate into the work only material that is inspected, tested, and accepted by the Department. Pay to remove unacceptable materials from the site at no expense to the Department.

B. The Department uses the most current Minimum Sampling and Testing Requirements, Materials Manual of Instruction Part 8, and AASHTO or ASTM standards.

C. The Department performs acceptance testing at its expense, unless otherwise designated.

D. The Department may inspect, test, and reject materials at any time.
   1. Copies of any or all test results are available upon request.

E. The Department does not allow any contract time extension for or as a result of any testing.

F. Pay for retesting of materials made necessary by the Contractor's activities.

G. All Department and Consultant/Contractor materials laboratories and materials test technicians must be qualified under the requirements of the UDOT Materials Manual of Instruction Part 8, to perform material sampling and testing.

1.11 COMPLIANCE CERTIFICATE

A. The Contract or the UDOT Minimum Sampling and Testing Requirements designate manufactured materials and assemblies that can be incorporated in the work if accompanied by certificates of compliance from the manufacturer.
   1. Clearly identify each lot of certified materials or assemblies delivered to the work and make certain the certificate of compliance accompanies each delivery and identifies the specification requirement satisfied.
   2. Make certain the certificates of compliance state the material or assemblies comply with applicable requirements of the Contract, and are signed by a manufacturer's representative in a position to legally bind the manufacturer.
      a. Photocopies, faxes, and electronically submitted PDF files are acceptable.

B. 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.

C. Obtain the required certificate of compliance from the Engineer.

1.12 PLANT INSPECTION

A. Department may inspect materials at the acquisition or manufacturing source for compliance with specified manufacturing methods. The Department obtains and tests material samples for compliance with quality requirements.

B. Cooperate fully and assist the Engineer during the inspection.
   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. Equip crushing or screening facilities with automatic or semiautomatic mechanical sampling devices.

C. The Department rejects material not meeting contract requirements.

1.13 MATERIAL STORAGE AND HANDLING

A. Store and handle materials to preserve their quality and fitness for the work.

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 retested.

D. Obtain approval from the Engineer to store materials or equipment within the right-of-way.

E. Additional storage space is at the Contractor's expense and option.
   1. Obtain owner's or lessee's written permission before storing material on private property.
   2. Furnish copies of the permission to the Engineer if requested.

F. Pay to restore storage and plant sites to their original condition or to the satisfaction of the Engineer.

1.14 UNACCEPTABLE MATERIALS

A. Engineer rejects all materials not meeting the contract requirements.

B. Remove unacceptable materials immediately from the project site unless the defects are corrected and approved by the Engineer or accepted at a reduced price.

1.15 DEPARTMENT FURNISHED MATERIALS

A. Deliver or make available Department furnished materials at the locations specified in the Contract. Receive, inventory, store, protect, distribute and install Department furnished material.

B. Include the cost of handling and placing Department furnished materials in the contract price for the item for which the materials are used.

C. 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 delivery.
   2. The demurrage charges resulting from failure to accept the material at the designated time and point of delivery.

1.16 BUY AMERICA

A. Federal-aid projects are subject to Title 23, U. S. Code of Federal Regulations, 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 and uses only domestic steel and iron in the Contract.
   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 steel and iron used and all products manufactured from steel and iron must be produced in the United States to be considered domestic.
   1. All manufacturing processes including application of a coating must occur in 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 covered under Buy America.

C. Provide a written certification that all contract items using steel and iron are of domestic supply if 100 percent steel and iron is furnished.

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

1.17 CONVICT PRODUCED MATERIALS

A. Federal-aid projects are subject to Title 23, U. S. Code of Federal Regulations, 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 addressing disputed acceptance or verification results for the following materials on Department projects:
   1. Section 02056 – Embankment, Borrow, and Backfill
   2. Section 02721 – Untreated Base Course
   3. Section 02741 – Hot Mix Asphalt
   4. Section 02743 – Hot Mix Asphalt – Bike and Pedestrian Paths
   5. Section 02744 – Stone Matrix Asphalt
   6. Section 02752 – Portland Cement Concrete Pavement
   7. Section 02785 – Chip Seal Coat
   8. Section 02786 – Open-Graded Surface Course

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02721: Untreated Base Course

C. Section 02741: Hot Mix Asphalt

D. Section 02743: Hot Mix Asphalt – Bike and Pedestrian Paths

E. Section 02744: Stone Matrix Asphalt

F. Section 02752: Portland Cement Concrete Pavement

G. Section 02785: Chip Seal Coat

H. Section 02786: Open-Graded Surface Course

1.3 REFERENCES

A. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

B. AASHTO T 193: The California Bearing Ratio

C. AASHTO T 312: Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

D. AASHTO T 324: Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

E. AASHTO TP 62: Determining Dynamic Modulus of Hot Mix Asphalt Concrete Mixtures

F. Asphalt Institute Manual SP-1

G. UDOT Materials Manual of Instruction

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Engineering analysis within one week of receipt of test results or 24 hours prior to performing any work that may prevent the evaluation, correction, or removal of the lot in question.
   1. Engineering Analyses will be accepted if based on test results performed by an AASHTO accredited lab that has performed a split-sample process with the Department.

1.6 DISPUTE RESOLUTION PROCEDURE

A. The Contractor may dispute the validity of the Department's acceptance or verification tests.

B. Include at a minimum the following items in the engineering analysis:
   1. Data supporting the Contractor's test results. Data must be based on project quality control testing.
      a. Split-sample testing performed within the applicable contract
      b. Contractor's test data for the disputed results, along with all supporting test data and calculations for calculated values such as Bulk Specific Gravity, Maximum Specific Gravity, and Ignition Oven results for disputing VMA.
      c. Successful Laboratory Correlation information when required by material specification
   2. Procedures or issues leading to disputed acceptance test results.
   3. Incentive/Disincentive calculations based on both Contractor and Department test values, individually.

C. The Department immediately reviews the submittal when construction schedule indicates that a reject lot will be covered within 48 hours to determine if it has merit. The Department immediately suspends work related to the lot in question if merit is found. The Department reviews the analysis to identify possible discrepancies that can be resolved through validation testing based on the following if merit is found:

1. Department performs repeat testing on remaining material from original Department test.
2. Department personnel perform repeat testing in the presence of Contractor representative within a 24 hour time period.
3. Use results to validate or invalidate original Department result. Validation test results may not be used in lieu of acceptance results.
4. Base validation on results within two standard deviations (project acceptance samples) of original acceptance result. Remove invalidated test results from acceptance lot and reevaluate lot based on reduced sample size.
5. The Engineer reviews the results and notifies the Contractor of any findings that affect the reject status of the lot along with the Department's position on whether the lot is to be removed or may remain in place at the pecuniary deduction for Reject Lot.

D. The Resident Engineer, Region Materials Engineer, and Region Construction Engineer review the analysis and notify the Contractor in writing of acceptance or rejection within three working days of receipt. 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.

E. The Department along with the Contractor immediately begins a review of the acceptance test results when the Department concludes the engineering analysis has merit. The review includes but is not limited to the following:

1. Independent Assurance review of all equipment and 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.

Note: The Engineer may verify contractor test values based on engineering analysis if engineering analysis is initiated due to failure of statistical methods to verify Contractor testing and there is no net difference between incentive/disincentive based on Contractor or Department testing.

F. Do not continue production related to the material type in question without concurrence from the Engineer or until differences in the test results are resolved.

G. The Department corrects the applicable test results and re-applies the acceptance/pay adjustment procedures if errors in testing or reporting are discovered.
   1. The Department may choose to evaluate the lot using the Hamburg Wheel Tracker (AASHTO T 324) or the Asphalt Pavement Analyzer (UDOT Materials Manual of Instruction Part 8-958: Standard Test Method for Determining Rutting Susceptibility using the Pavement Analyzer) if errors are identified that cannot be corrected and the quality of a Hot Mix Asphalt or Stone Matrix Asphalt lot is in question.
      a. Use 5 stratified random samples cut from the roadway
      b. The Region Materials Engineer and Resident Engineer decide along with the Contractor the status of the lot and associated pay adjustment based on the following:
         1) Fatigue Life
         2) Stripping Potential
         3) Rutting Potential
         4) Expected Pavement Performance Period vs. Design Life

H. 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. The Independent Third Party identifies and produces additional material for split-sample testing.

I. The Department makes appropriate adjustments to the acceptance test results and re-applies the acceptance/pay adjustment procedures if testing errors are identified by the Third Party.

J. The party responsible for the identified error pays for the services of the Independent Third Party.

K. The Department evaluates the lot using the original testing results if no errors are identified.

L. Review of the Contractor's schedule and adjustments to the CPM are required when errors are identified in the Department's testing result. Time lost due to a rejected analysis is not credited to the CPM and appropriate liquidated damages will be applied.

M. The Contractor may request that "reject material to be removed" be left in place at a reduced pay. Include in the engineering analysis the following and any other additional items appropriate for the material in question when requesting "reject material to be removed" be left in place:

1. Determine volumetric, durability, and long-term structural properties from one or more of the following tests:
    a. Hamburg Wheel Track Testing of Compacted Bituminous Mixtures. Refer to AASHTO T 324.
    b. Resistance of Compacted Bituminous Mixture to Moisture Damage. Refer to UDOT Materials Manual of Instruction Part 8-957.
    c. Standard Test Method for Determining Rutting Susceptibility Using the Pavement Analyzer. Refer to UDOT Materials Manual of Instruction Part 8-958.
    d. Dynamic Modulus Evaluation. Refer to AASHTO TP 62.
    e. PG Asphalt Binder Tests, SP-1
    f. SuperPave Volumetric Properties. Refer to AASHTO T 312.
    g. California Bearing Ratio. Refer to AASHTO T 193.
    h. Coring and Testing Drilled Cores and Sawed Beams from Concrete Pavement. Refer to AASHTO T 24.
2. Recommend price adjustment based on expected long-term performance.

N. The Department will take no further action after the response is submitted to the Contractor.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

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, advance warning arrow panels, and pilot cars.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 00725: Scope of Work

C. Section 00727: Control of Work

D. Section 00820: Legal Relations and Responsibility to the Public

E. Section 01558: Temporary Pavement Markings

F. Section 02891: Traffic Signs

G. Section 02765: Pavement Marking Paint

1.3 REFERENCES

A. AASHTO Roadside Design Guide, Current Edition

B. ATSSA: American Traffic Safety Services Association
Quality Standards for Work Zone Traffic Control Devices

C. Manual on Uniform Traffic Control Devices (MUTCD), Current Edition

D. NCHRP- Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features

E. UDOT Flagger Training Handbook

F. UDOT Guidelines for Crash Cushions

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 BIDDING REQUIREMENTS

A. The apparent low bidder:
   1. Submit three copies of the Traffic Control Plan to the Engineer no later than the fourth Wednesday following bid opening. Submit plans in 11 inches x 17 inches format prepared using CAD software. All plans must be signed and sealed by a professional engineer licensed in the State of Utah. When available, the Department will provide basemap CAD files in Microstation format to the Contractor on a CD-ROM at no cost.
   2. Attend a mandatory meeting at the time and location as directed by the Engineer:
      a. Contractor's Traffic Control Designer
      b. Contractor's Traffic Control Maintainer
      c. Resident Engineer
      d. Region Traffic Engineer or designated representative
   3. Ensure compliance with the plans and specifications. Modify plan if necessary to meet all applicable requirements.
   4. The Department will grant no additional contract time for preparing or modifying the Traffic Control Plan.
   5. Do not begin work until the Traffic Control Plan is implemented for that phase of work. Do not implement traffic control until written authorization is received from the Engineer.

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. Some exceptions will be acceptable as stated below.
   1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.
   2. Category 2: Portable sign stands with signs, Type I, II and III barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause significant vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350 Report test requirements.

3. Category 3: Portable/Temporary pre-cast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements.
    a. Manufactured date to be stamped into top of each barrier section using a numeric format such as 10/2002 with 2 inch x 2 inch numerals, ¼ inch deep. Refer to BA Series Standard Drawings.
    b. Portable/Temporary pre-cast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP 230 may be used until they are no longer serviceable.
4. Category 3: Crash Cushions and Truck Mounted Attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements.
    a. The appropriate GREAT CZ, manufactured by Energy Absorption Systems, may be used until they have completed their normal service life.
5. Category 4: Advanced Warning Arrow Panels and portable variable message signs do not have to meet NCHRP-350 Report test requirements.

1.8 TRAFFIC CONTROL PLAN REQUIREMENTS

A. Design Traffic Control Plan resolving discrepancies between the various standards for traffic control in accordance with Section 00727 and the following:
    1. Refer to SN Series Standard Drawings for post mounted signs and TC Series Standard Drawings.
    2. Manual on Uniform Traffic Control Devices (MUTCD) Current Edition

B. Follow the requirements and limitations identified in the Traffic Control Special Provision if included, Section 00555, Section 00725, and Section 00820.

C. Consider the safe and efficient movement of traffic when lane closures are proposed.
    1. Open lanes to traffic wherever and whenever practical.
    2. Minimize and restrict lane closures to the locations and times essential for prosecution of work.

D. Provide concrete barrier and attenuation to satisfy hazard mitigation. Refer to TC Series Standard Drawings.

E. Provide for delineation and temporary pavement markings and removal as needed for traffic control or as required in accordance with this Section, article 1.6, Traffic Control Plan Requirements, paragraphs H and I.

F. Provide concrete barrier or other positive protection for all hazards such as bridge parapets, barrier blunt ends, poles, large equipment to include but not limited to cranes, pile drivers etc. when hazard is within AASHTO clear zone requirements for approach traffic.

G. Use the following format and provide the following documentation:
   1. Section I: Description of each phase
      a. List phases and corresponding bid items and elements of work to be accomplished in each phase.
      b. Accounting for each contract bid item and element of work. Reference the traffic control detail designed to provide for the safe and efficient movement of traffic and safety of workers.
      c. All contract bid items and elements of work must be identified and included in the phasing.
   2. Section II: CAD generated drawings showing detailed Traffic Control Plan for each phase:
      a. Adapt Standard Drawings and work zone traffic control examples contained in the MUTCD to reflect actual project conditions such as curves, grades, presence of ramps, intersections, and accesses.
      b. Use basemap CAD files when supplied by the Department as a basis for the Traffic Control Plan drawings.
      c. Use the same level of detail as in the MUTCD and UDOT TC Series Standard Drawings.
      d. Include the anticipated duration of the traffic control setup used in each phase.
      e. Provide for the safe passage of pedestrians and bicyclists through the work zone in accordance with the Americans with Disabilities Act and the MUTCD.
      f. Clearly indicate the following:
         1) Proposed regulatory speed reductions in accordance with this Section, article 3.6, Construction Zone Speed Limit Requirements.
         2) For all tapers: length of taper, device spacing, lane or shoulder closures, amount of lane shift in accordance with this Section, article 3.3, Traffic Control Signing and Devices, paragraph A.
         3) Length of buffer zone, in accordance with this Section, article.3.3, Traffic Control Signing and Devices, paragraph A.
         4) Device spacing used in tangents in accordance with this Section, article 3.3, Traffic Control Signing and Devices, paragraph B.

5) Lengths of work zones, lane and shoulder widths and area available for vehicle recovery
6) Proposed changes to be made to existing traffic signals including: timing changes, phase changes, etc.
7) Sign locations for required and existing signs.
8) Existing signs that are to be removed, covered, relocated or otherwise changed from the original configuration.
9) Worker parking, work vehicle and equipment access to and from work area, staging and material sites.

3. Section III: Emergency and Special Situations
   a. Identify procedures for dealing with emergencies and special situations.

H. Provide temporary pavement markings on newly constructed asphalt pavement and refresh as needed until the final surfacing is placed in accordance with Section 01558 as directed by the Engineer.

I. Completely remove all existing traffic markings that conflict with the Traffic Control Plan, in accordance with Section 02765. Do not use paint or other material to cover markings.

1.9 TRAFFIC CONTROL MAINTAINER

A. Certified by the Department or by the American Traffic Safety Services Association (ATSSA) as a Traffic Control Technician. Certifications are available through the web site at http://www.udot.utah.gov/go/standardsreferences for each of the below.

Associated General Contractors
1135 South West Temple
Salt Lake City, Utah
Telephone: 801-363-2753

American Traffic Safety Services Association
15 Riverside Parkway Suite 100
Fredericksburg, Virginia 22406-1022
Telephone: (800) 272-8772

Utah LTAP Center
411 Old Main Hill
Logan, Utah 84322-4111
Telephone (800) 822-8818

B. Authority:
   1. Obtains and uses all labor, equipment, and materials necessary to maintain traffic control.
   2. Changes traffic control operations per the traffic control plan.

C. Responsibilities and Duties:
   1. Oversees all traffic control operations.
   2. Implements the Traffic Control Plan.
   3. Remains available 24 hours a day, seven days a week and can be on-site within 30 minutes of notification.
   4. Corrects deficiencies immediately upon verbal or written notification from the Engineer or representative.
   5. Inspect and document inspections of traffic control on a form acceptable to the Engineer at least four times each day, at least one of which must be conducted during nighttime hours.
      a. Before beginning of shift.
      b. At mid-shift.
      c. Half-hour after shift ends.
      d. At the midpoint of the off-shift period.
   6. Coordinates project traffic control with emergency services and local law enforcement agencies.
   7. Inspect and document inspections of traffic control twice each day when no construction work is being done.
      a. One during day light hours and one during night time hours
      b. Conduct inspections a minimum of eight hours apart
   8. Completes a daily record of traffic control activities using a form acceptable to the Engineer.
   9. Submit to the Engineer inspection and activities forms each week on a day and time acceptable to the Engineer.
   10. Provide a daily report of all planned traffic control activities to the Engineer by 7:00 a.m. each day. Provide the report each day during the contract.

1.10 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL

A. Implement and maintain traffic control per the Traffic Control Plan. Implement changes to traffic control required in order to meet UDOT Standard Specifications, Drawings and MUTCD at no additional cost to the Department. Coordinate changes to traffic control and the Traffic Control Plan with the Engineer prior to implementation.

B. Meet all requirements of this Section, article 1.7, Traffic Control Maintainer when traffic control devices are required to be in place overnight or on weekends.

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 weekly unless conditions warrant more frequent cleaning.

D. Maintain traffic control devices during and after all snow plowing operations at no additional cost to the Department. Clear snow away from all traffic control devices so that the devices function as intended.

1.11 WAGE RATES FOR TRAFFIC CONTROL PERSONNEL (FEDERAL AID JOBS ONLY)

A. State payment of wages as indicated below during the time the certified Traffic Control Maintainer or others involved in setting up or maintaining traffic control devices working under the direction of the certified Traffic Control Maintainer is on the project site and does any of the following work:
   1. Laborer I - for moving traffic control devices by hand; loading or unloading devices on to or off of the truck; and for all hours required to be at the project site except those hours spent in the truck driver classification.
   2. Truck Driver - for all hours spent driving on the project site in the performance of the duties required to maintain the traffic control. The rate of pay is determined by the size of vehicle being driven, Pickup Truck being the smallest.

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.

2. A Stop Work order issued due to non-compliance with this specification is not considered to be an authorized suspension of contract time. Contract time will continue to accrue as defined Section 00555.

C. Include in the bid item Traffic Control all materials, equipment, labor, flagging, pilot car, temporary pavement markings and removal or both and workmanship required for the design, implementation, and maintenance of the Traffic Control Plan.

D. Provide the Engineer in writing with a detailed analysis showing impacts to traffic control caused by extra work that necessitates modification to the Traffic Control Plan. Negotiate and agree to either a lump sum price for additional Traffic Control or agree to unit prices to be used for additional Traffic Control measures or devices required, prior to performing the extra work.

PART 2 PRODUCTS

2.1 PILOT CAR

A. Equip with a reflectorized sign:
   1. Comply with Section 02891
   2. MUTCD sign G20-4

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

2.2 FLAGGER EQUIPMENT AND CLOTHING

A. Comply with to the Department's Flagger Training Handbook.

B. Comply with TC Series Standard Drawings.

C. Clothing:
   1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors:
      a. Safety vest with a minimum of 775 square inches of background material. Night work requires a minimum of 201 square inches of reflective material, 100 2-square inches on the front and 100 2-square inches on the back. Reflective material will be white or strong yellow-green.

b. Hard hat with 10 square inches of white or strong yellow-green reflective 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 this Section, article 1.5, Certifications
2. Comply with Section 02891
3. Comply with TC Series Standard Drawing
4. Comply with SN Series Standard Drawing when using post mounted signs

B. Channelizing Devices:
1. Comply with this Section, article 1.5, Certifications
2. Comply with TC Series Standard Drawing
3. Meet or exceed ASTM Type VI for flexible signs

C. Precast Concrete Barrier:
1. Comply with this Section, article 1.5, Certifications
2. Comply with TC Series Standards Drawings
3. Use an approved construction zone attenuator or permanent style end sections, as listed in UDOT Guidelines for Attenuators and End Section.
   a. Use a construction zone attenuator when approach ends of temporary precast barrier are within 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.
4. Do not use a truck-mounted attenuator (TMA) to protect temporary precast barrier end for more than 24 hours. Use properly rated TMA as directed in this Section, article 2.3, Traffic Control Signing and Devices, paragraph D.

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.

2.4 ADVANCE WARNING ARROW PANEL

A. Advance Warning Device:
1. Meet all standards as specified in the MUTCD, Section 6F.53 Arrow Panels.

2. Refer to the TC Series Standard Drawings and the MUTCD.

PART 3 EXECUTION

3.1 TRAFFIC CONTROL PLAN MODIFICATION

A. Each phase of construction must use an authorized Traffic Control Plan. If a construction phase is proposed that is not covered by the Traffic Control Plan, submit a plan to the Engineer for review.
   1. Submit plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented.
   2. Do not begin work until the Traffic Control plan is authorized for use, and has been fully implemented.
   3. Implement changes required to meet UDOT Standard Specifications, Standard Drawings and MUTCD at no additional cost to the Department.
      a. Comply with this Section, article 1.4, Bidding Requirements, paragraph A, line 1.

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 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 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 posted speed during construction to compute the tangent spacing for channelizing devices.

C. Remove all traffic control from site of work when not required within 24 hours.
   1. Remove traffic control devices from the roadway a distance twice that of the Construction 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 when directed by Engineer.
      a. Cover signs completely with an opaque and durable covering.

3.4 ADVANCE WARNING ARROW PANEL

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 Advance Warning Arrow Panel 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.
   1. Each approach is to be controlled by a 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 region traffic engineer. Use speed reductions only during impacted times and areas. Restore existing regulatory speed limit prior to work at locations where traffic is not being impacted by work activities. Refer to http://www.udot.utah.gov/go/standardsreferences for policy information.
   1. Refer to TC Series Standard Drawings.
   2. Use speed reduction only when construction activities impact traffic.
   3. Restore regulatory speed limit at locations where construction activities are not impacting traffic.
   4. Refer to SN Series Standard Drawings for post mounted sign requirements.

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 01554: Traffic Control

B. Section 02765: Pavement Marking Paint

C. Section 02842: Delineators

1.3 REFERENCES

A. ASTM D 4592: Preformed Plastic Pavement Marking Tape for Limited Service Life.

B. ASTM D 4956: Retroreflective Sheeting for Traffic Control

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 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 bid item included in the proposal.
   2. Include all costs in Traffic Control or other items of work when there is no bid item included in the proposal.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING PAINT AND GLASS BEADS

A. Refer to Section 02765.

B. Accepted upon approval of the weights and analysis stated on the containers.

2.2 PAVEMENT MARKING TAPE

A. ASTM D 4592, Type I (Removable)

B. Minimum reflective values:
   1. ASTM D 4592

2.3 RAISED PAVEMENT MARKERS

A. Provide plastic raised pavement markers having reflective material with clear covers as needed for the particular application.
   1. Marker body to be manufactured of polyurethane plastic in color specified for required type.
      a. Width 4 inches, height 2 inches, thickness 0.06 inches.
   2. Reflective sheeting to be a minimum area of 1.50 in^2. Sheeting to meet ASTM D 4956 Type 1 material minimum.
   3. Provide clear polyvinyl chloride covers attached to marker body with heavy duty staples when appropriate for the particular application or work operation.
   4. Marker to be supplied 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 when and where delineation is removed or nonexistent. Refer to Section 02842.
   2. Broken line pavement markings are 3 ft long, spaced on a 40 ft cycle length.

B. Refer to Section 02765 for preparation requirements.

C. 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.

D. Place transverse marking, using 4 x 24 inch pavement marking tape across exposed longitudinal joint for pavement vertical grade separation greater than 1 inch.
   1. Place markings on a 25 ft spacing.

3.2 PAVEMENT MARKING PAINT AND GLASS BEADS

A. Apply Pavement Marking Paint at the following rates:
   1. 4 inch solid line at 480 to 510 ft/gal.
   2. 4 inch by 3 ft broken line at 6400 to 6800 ft/gal.

B. Apply glass beads at a minimum 6 lbs/gal of paint, over full length and width of lines and pavement markings.

C. Re-apply Pavement Marking Paint at two-week intervals or at a frequency as directed by the Engineer in order 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 in order to maintain markings that provide a clear path during night and twilight periods and wet pavement conditions.

C. Inspect and replace any loose, missing, or damaged pavement markings immediately. Refer to Section 01554.

D. Remove the tape immediately before paving.

3.4 RAISED PAVEMENT MARKERS

A. Attach raised pavement marker as per manufactures recommendations.

B. Space raised pavement markers as follows:
   1. Solid line: on 10 ft centers.
   2. Broken line: Two on 3 ft centers spaced on a 40 ft cycle length.

C. Inspect and replace any loose, missing, or damaged markers immediately. Refer to Section 01554.

D. Remove markers immediately before paving.

END OF SECTION

SECTION 01571

ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for controlling erosion and reducing sediment leaving the construction site and areas under the Contractor's control.

B. Requirements for installing, inspecting, maintaining, and removing temporary erosion control measures.

C. Requirements when an Environmental Control Supervisor (ECS) is included as a bid item in the proposal.

D. Materials and procedures for installing and removing temporary environmental fencing.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02373: Riprap

C. Section 02376: Erosion Control Blankets/Channel Liners

D. Section 02610: Pipe Culverts

E. Section 02613: Culvert End Sections

F. Section 02911: Mulch

1.3 REFERENCES

A. AASHTO M 281: Steel Fence Posts and Assemblies, Hot Wrought

B. AASHTO M 288: Geotextile Specifications for Highway Applications

C. Storm Water Pollution Prevention Plan (SWPPP)

D. Utah Storm Water General Permit for Construction Activities

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Prepare and submit a Notice of Intent (NOI) for Storm Water Discharges associated with Construction Activity to the Division of Water Quality at the Utah Department of Environmental Quality (DEQ) along with a signed copy of the NOI to the Engineer, when disturbing one or more acres. NOI forms can be completed online at Division of Water Quality website. Refer to: http://www.udot.utah.gov/go/standardsreferences.

1. Submit a Notice of Termination (NOT) form to the Division of Water Quality to terminate the permit, along with a signed copy to the Engineer at the end of construction.

B. Submit certification to the Engineer that the ECS has completed and passed the examination for the UDOT Environmental Control Supervisor training when the contract proposal includes a bid item for Environmental Control Supervisor (ECS). Contact the UDOT Environmental Division for more information.

1.6 TYPES

Refer to EN Series Standard Drawings.

A. Check Dam:

1. A fiber roll or stone structure placed across a ditch to intercept and trap sediment. Construct so water will flow over a low point in the middle of the dam and not around the sides.

B. Silt Fence:

1. A geotextile fabric fence to intercept and trap sediment.

C. Slope Drain:

1. A polyethylene pipe 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.

D. Temporary Berm:

1. A ridge of compacted soil, with or without a shallow ditch that diverts storm runoff from a slope to a controlled release point.

E. Drop inlet Barrier:

1. A fiber roll, silt fence, or stone barrier placed around a drop inlet that intercepts and traps sediment.

F. Pipe Inlet Barrier:
   1. A barrier protecting a pipe inlet that intercepts and traps sediment before it enters the pipe.

G. Curb Inlet Barrier:
   1. A protective barrier placed across a curb inlet that intercepts and traps sediment before it enters the inlet.

H. Sediment Trap:
   1. An excavated basin, usually installed at low points on a construction site that intercepts and traps sediment. Location determined by the Engineer.

I. Stabilized Construction Entrance:
   1. A layer of rock placed at a construction site entrance that removes mud from vehicle tires before tracking onto a paved road.

J. Straw Bale Barrier:
   1. Straw bales placed end to end used where a silt fence would fail. Install to intercept and trap sediment.

K. Temporary Environmental Fence:
   1. A visual barrier used to delineate and prevent encroachment on sensitive areas.

1.7 PAYMENT PROCEDURES

A. Payment for the items associated with this section includes all costs for labor, equipment, and materials for installation, inspection, maintenance, and removal as required.

B. Liquidated Damages
   1. Liquidated damages are assessed against the Contractor in the amount of $500 for each calendar day or portion thereof the project is not in compliance with all required permits and regulations.
      a. The damages assessed are increased to $1,000 per day and increased to $1,500 per day after seven days if the Contractor remains not in compliance after three days.
   2. Fines issued by regulatory agencies against the Department are added to the liquidated damages assessed to the Contractor.
   3. No extension of contract time is allowed for any delay resulting directly or indirectly from a violation of environmental requirements.

1.8 ENVIRONMENTAL CONTROL SUPERVISOR (ECS) REQUIREMENTS

(This article applies only when an ECS is included as a bid item in the proposal)

A. Qualifications:
   1. Knowledge of erosion control principles and best management practices for roadway construction sites.
   2. Knowledge of the laws related to environmental clearances and how to obtain the clearances required under Section 01355.
   3. Ability to understand and implement environmental plans, details, and specifications.
   4. ECS certified by the Department.

B. Responsibilities:
   1. Implementation of environmental protection commitments and proper installation of mitigation measures associated with the project.
   2. Maintain the environmental compliance.
      a. Available 24-hours per day seven days per week to respond as necessary to maintain environmental compliance and to the direction of the Engineer.
   3. Obtain environmental clearances in accordance with Section 01355 for disturbances, waste sites, staging areas, etc. not specifically provided in the contract.
   4. Comply with the requirements of Utah Storm Water General Permit for Construction Activities – Permit No.: UTR100000. Refer to http://www.udot.utah.gov/go/standardsreferences
   5. Comply with all requirements of U.S. Army Corps of Engineers Nationwide or Individual Permit or a Utah Division of Water Rights Regional General Permit 40, when applicable.

C. Regulatory Agency Coordination:
   1. Work with the Engineer to maintain coordination and communication between the Contractor, Department, and regulatory agencies. Process all official communication through the Engineer.
   2. Coordinate and conduct on-site meetings on an as-needed basis with all regulatory agency inspectors.
   3. Notify the Engineer in writing of the results of any agency coordination meeting within 24-hours.

PART 2 PRODUCTS

2.1 MATERIALS

A. Check dams:
   1. Fiber Roll:
      a. Fiber Roll: Contact Engineer for currently approved products.
      b. Wood stakes: commercial quality lumber, nominal 2-inch square by 3 ft.
      c. Channel Liner: Contact Engineer for currently approved products.
   2. Stone: Well-graded within 2 to 6 inches in diameter.

B. Silt Fence:
   1. Silt Fence Fabric: See AASHTO M 288 (Table 6 – Temporary Silt Fence Property Requirements).
   2. Wood Post: commercial quality lumber, nominal 2-inch square by 4 ft.
   3. Fasteners: Staples, wire, zip ties, or nails sufficient to maintain fabric attachment to post.

C. Slope Drain:
   1. Pipe Culverts: Refer to Section 02610.
   2. End Section: Refer to Section 02613.
   3. Loose Riprap: Refer to Section 02373.
   4. Wooden stakes: commercial quality lumber, nominal 2-inch square by 3 ft.

D. Temporary Berm:
   1. Existing Soil.

E. Drop Inlet Barriers:
   1. Fiber Roll: Contact Engineer for currently approved products.
   2. Stone: Well-graded within 2 to 6 inch diameter.
   3. Silt Fence: See AASHTO M 288 (Table 6 – Temporary Silt Fence Property Requirements).
      a. Wood stud: 2 inches x 4 inches nominal.

F. Pipe Inlet Barrier:
   1. Stone: Well-graded within 2 to 6 inch in diameter.
   2. Fiber Roll: Contact Engineer for currently approved products.

G. Curb Inlet Barrier:
   1. Concrete Building Blocks.
   2. Stone: Well-graded within 2 to 6 inch diameter

3. Wire Mesh: 0.5 inch by 0.5 inch openings.
4. Wood stud: 2 inches x 4 inches nominal.

H. Sediment Trap:
1. Loose Riprap: Refer to Section 02373.

I. Stabilized Construction Entrance:
1. Stone: Well-graded within 2 to 3 inch in diameter.

J. Straw Bale Barrier:
1. Straw Bales: Obtained from weed free fields that have been certified by the Utah Department of Agriculture.

K. Temporary Environmental Fence:
1. Fence Fabric
   a. Polyethylene, high-density, UV stabilized
   b. Width: 4 ft minimum
   c. Color: orange
2. Posts
   a. Meet AASHTO M 281
   b. Painted or galvanized metal “T” post, 5 ft to 6 ft long

PART 3 EXECUTION

3.1 PREPARATION

A. Do not begin any earth-disturbing activity until the NOI form has been completed and submitted to the Division of Water Quality and the Engineer when disturbing one or more acres.

B. Understand and comply with the requirements of Utah Storm Water General Permit for Construction Activities.

C. Follow the Storm Water Pollution Prevention Plan (SWPPP) provided in the plan set.
1. Create and submit a plan to the Engineer if a SWPPP is not provided in the plans when any earth-disturbing activities are required.
   a. Address all disturbed areas including, but not limited to, staging areas, haul roads, borrow sites, stockpiles, and disposal areas.

b. Do not start earth-disturbing activity until the SWPPP is approved and project perimeter erosion control measures, and those protecting environmentally sensitive areas, are in place.
   1) Obtain written approval from the Engineer to change the SWPPP.

2. Work directly with the Engineer's designated ECS.
   a. Be available as needed to coordinate the SWPPP, inspect and maintain erosion control devices, and resolve other sediment and erosion control issues.

3. Maintain a copy of the approved SWPPP with the following information on the project site at all times:
   a. SWPPP title sheet
   b. EN Series Standard Drawings
   c. Erosion and sediment control plan sheets
   d. Project specific details and all contract specifications

D. Use the most restrictive requirement if a conflict occurs between erosion and sediment control specifications and federal, state, or local agency laws, rules, or regulations.

E. Install temporary environmental fence, when required, before construction begins.

3.2 INSTALLATION

A. The erosion control measures in the SWPPP are illustrative. Adapt measures in the field to meet their intended purpose and implement appropriate erosion control measures necessary as the project progresses. Make required changes to the SWPPP to accommodate construction sequencing with the approval of the Engineer.

B. The Engineer may direct the installation of additional erosion control measures. Install additional erosion control measures as directed.

C. Follow installation procedures outlined in the EN Series Standard Drawings.

D. Provide or construct measures such as check dams, silt fence, slope drains, drop inlet barriers, sediment traps, and other erosion control devices or methods to reduce erosion and sedimentation.

E. Install stabilization measures as soon as practical on newly disturbed areas but in no case later than 14 days after disturbance unless further construction activity precludes installation and will resume inside that area within 21 days from when activity ceased. Refer to Sections 02376 and 02911.
   1. Install stabilization measures before seasonal shut down.

F. Install temporary environmental fence in the required locations.
   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 wire or plastic ties.

3.3 INSPECTION

A. Inspect all denuded areas during construction to determine potential erosion problems. Apply corrective measures as required.

B. Inspect erosion control measures, including sediment retention structures, at least once per week upon beginning earth-disturbing activities and within 24 hours after any storm event greater than ½ inch. Conduct inspections at least once per month when construction activities are temporarily or seasonally shut down.
   1. Invite the Engineer to inspections.
   2. Complete an inspection report after each inspection and submit it to the Engineer within 24 hours of the inspection. Include the following information:
      a. Names of personnel attending, and date of the inspection.
      b. List of problems identified in the previous inspection and note whether or not corrections have been made.
      c. List by location, earth-disturbing activities since previous inspection.
      d. List by location, erosion and sediment control measures installed since previous inspection.
      e. List by location, new and unresolved problems encountered with specific erosion control measures. Describe solutions to be implemented.

3.4 MAINTENANCE

A. Maintain erosion control devices in order that they function properly until all disturbed areas draining to them are stabilized.

B. Remove and properly dispose of sediment when it has accumulated half way up the overall structure height, or when it interferes with the performance of the structure.

C. Dispose of sediment removed from erosion control structures in a manner acceptable to the Engineer.

3.5 REMOVAL

A. Remove any remaining sediment from behind and around erosion control features and remove all temporary erosion control features unless directed differently by the Engineer after all seeding and mulching has been placed and within two weeks of project acceptance.

B. Remove temporary environmental fence and posts upon completion of construction.
   1. Temporary environmental fence and all components becomes property of the Contractor when construction is complete.

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 prewetting, 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 PROCEDURES

A. Reapply water at no additional cost to the Department when material containing natural or applied water is allowed to dry due to the Contractor's inattention or neglect.

B. The Department will not pay separately for furnishing or applying water used in:
1. Hot plant wet collectors.
2. Areas around all HMA and PCC plants, pits, and crusher operations.
3. Roads used to haul materials to and from project site.
4. Rotomilling, sawing, or grinding operations.
5. Maintaining plant life.
6. Lean concrete base and portland cement concrete pavement.
7. Aggregate washing.
8. Wetting foundations before concrete work.
9. Concrete curing.
10. Other items of work for which water is desired as incidental to and included in payment.

PART 2 PRODUCTS

2.1 WATER

A. Free of dirt, silt, or 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. Pressure pump must have the capacity to apply the whole load uniformly.

B. Pressure system must operate at least 75 percent of the time during five successive work days or be removed from the project. A gravity flow spray system may be used for the remainder of the shift in case of pressure system failure.

C. Water truck: 1,000 U.S. gallons minimum capacity, with the capacity clearly and permanently marked on the tank. Engineer may require Contractor to verify capacity.

D. Metered pipeline may be used when prewetting. Apply at a rate and nozzle size to obtain desired results.

PART 3 EXECUTION

3.1 APPLICATION

A. Apply water for dust control in quantities and locations as directed by Engineer. Dust control may be required at any time. Do not waste water.

END OF SECTION

SECTION 01721

SURVEY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule, coordinate, and provide all construction surveying, staking, measurement, and calculations essential to complete the project and properly control the entire work.

B. Directed surveying as requested by the Engineer.

1.2 RELATED SECTIONS

A. Section 02765: Pavement Marking Paint

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 MEASUREMENT PROCEDURES

A. Directed Survey: Use a 2-Person Crew measured by the hour authorized if extra survey work is needed. Department makes no additional payment for travel time to and from the project.

B. Directed Survey: Use a 3-Person Crew measured by the hour authorized if extra survey work is needed. Department makes no additional payment for travel time to and from the project.

1.7 PAYMENT PROCEDURES

A. Include the costs in all items of work that require survey if contract does not include separate pay item for survey. Failure to comply with any portion of this specification may result in withholding up to 25 percent of contract payments until the deficiencies are corrected.

B. Directed survey work paid for in the accepted quantities if needed and approved at the following rates:

2 person survey crew	$130.00 per hour
3 person survey crew	$155.00 per hour
1 person computation, CAD, or both	$ 65.00 per hour

C. The number of hours required for computations and drafting in total cannot exceed 33 percent of actual survey hours, established on a percent basis prior to directed survey work starts.

1.8 SUBMITTALS

A. The Department requires that all submittals be signed and sealed by a Professional Engineer or Professional Land Surveyor licensed in the State of Utah.

B. Resubmittals may be required depending on completeness and correctness of the work.

C. Submit a statement prior to beginning work indicating all Department-provided horizontal and vertical control have been field checked and the control has been determined to be accurate within the tolerances specified in this section. Attach field survey information used to verify control. Notify the Engineer verbally and in writing if discrepancies are found.

D. Provide a written description of the equipment prior to beginning work including calibration certifications, manpower, methods, and data storage format proposed for use to complete all survey activities.

E. Record keeping: Keep all field notes, diaries, and books according to standard surveying practice.
   1. Loose leaf books not acceptable.
   2. Make available at any time all survey records including field notebooks and forms used for the work to the Engineer upon verbal or written request.

F. Return all surveying and design data to the Engineer after project completion. Provide a red-lined hard copy plan set showing as-constructed features denoting changes from the original design.

1.9 QUALITY ASSURANCE

A. Contractor is responsible for survey and control of the work and for correcting Contractor errors whether the errors are discovered during the actual survey work or in subsequent phases of the project and bears any cost overruns resulting from errors.

B. Perform all work in accordance with the plans and specifications and standard Engineering and Surveying practices under the responsible charge of a Professional Engineer or Professional Land Surveyor licensed in the State of Utah.

C. The Engineer may spot check the work for accuracy and may reject unacceptable portions of work. Resurvey rejected work and correct work that is not within the specified tolerances at no additional expense to the Department.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish tools, supplies, and stakes suitable for use in highway survey work.

B. Furnish 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. Furnish survey instruments and supporting equipment capable of achieving the specified tolerances. Calibrate survey equipment for accuracy prior to beginning survey work and as required.

PART 3 EXECUTION

3.1 PREPARATION

A. Discuss and coordinate the following with the Engineer before survey work begins:
1. Required submittals
2. Survey and staking methods
3. Stake markings
4. Grade control
5. Referencing
6. Structure control
7. Any 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. Verify all control surveying and staking meets specified tolerances for prior to beginning work.

C. Calculate all grades, elevations, offsets and alignment data necessary for staking or setting items of work. Obtain approval from the Engineer for alternate methods of establishing grade control with wire lines, computer or laser controlled grading or other suitable methods.

D. Provide appropriate traffic control for all survey activities.

E. The Department furnishes:
   1. Plans showing locations of control points
   2. Plans showing locations of Bench Marks
   3. Cross sections developed during design, if any
   4. Electronic project data, if any
   5. Digital Terrain Model used for design, if any

CONTRACT PROVISION DISCLAIMER

RELEASE OF UDOT DATA: Contractor may obtain an electronic copy of the Data Points prepared by UDOT. UDOT provides data points in Microstation or Inroads format only. Contractor responsible for translation into other formats. This data does not include the commercial software needed to read the points. In order to obtain an electronic copy, Contractor makes a written request to the Engineer. Contractor agrees and understands that the data points are prepared by UDOT for its own purposes and not for the benefit of private individuals or businesses. Contractor waives any and all claims that may result from the use of or reliance upon the data points. Contractor indemnifies UDOT and holds it harmless for any damages, costs, attorneys' fees, or other liabilities that might be incurred as a result of the Department's use and reliance on the data.

3.2 DIRECTED SURVEY

A. Conduct directed surveying if requested by the Engineer.
   1. Includes work needed for changes and extra work. Provide all labor, materials, and equipment including global positioning satellite equipment.
   2. Obtain prior written authorization from the Engineer documenting the affected work and requirements before performing work under these items.

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 prior to backfill.
      b. Take cross sections at a maximum centerline spacing of 25 ft when the centerline curve radius is less than or equal to 500 ft.
      c. Take cross sections at a maximum spacing of 50 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 25 ft unless otherwise approved by the Engineer.
f. Measure and record points to at least the anticipated slopes and reference locations.
g. Reduce all 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 all grades, locations, and existing ground line profiles.

3. May develop cross sections from digital terrain models provided if:
   a. Ground survey locations do not exceed 100 ft in any direction.
   b. Major breaks in terrain are also included.
   c. Horizontal and vertical control for the project is used.
   d. DTM is verified accurate to require tolerances by spot. checking throughout the length of the project.

B. Engineer may approve alternate methods of calculating quantities.

3.4 STAKE MAINTENANCE AND MARKINGS

A. Maintain ALL staking necessary for the work until the construction has been completed and accepted by the Engineer.
   1. Legibly mark all survey stakes with station and offset referenced to their respective control line.
   2. Mark slope, reference, and guard stakes with station.
   3. Renew illegible stakes at no additional cost to the Department.

B. Provide and maintain reference stakes that identify stationing at least every 100 ft until all work has been completed and accepted by the Engineer.

3.5 CONTROL POINTS AND SURVEY TOLERANCES

A. Relocate initial horizontal and vertical control points in conflict with construction to areas that will not be disturbed by construction operations. Furnish the coordinates and elevations for the relocated points before the initial points are disturbed.

B. Protect benchmarks from construction activities. Position all benchmarks to allow a level rod to stand vertically and squarely on the mark. Reference benchmarks to centerline and horizontal measurements.

C. Survey and establish control within the following tolerances:

Table 1

Survey Control		
Description	Horizontal	Vertical
	Decimals of a foot	
Control points	± 0.01	± 0.01
Centerline points	± 0.03	± 0.02
Cross sections and slope stakes	± 0.10	± 0.10
Slope stake references	± 0.10	± 0.10
Culverts and Ditches	± 0.10	± 0.05
Minor drainage structures	± 0.10	± 0.03
Curb and gutter	± 0.02	± 0.02
Guardrail and concrete barrier	± 0.05	± 0.05
Retaining walls	± 0.05	± 0.01
Bridge substructure and overall	± 0.01	± 0.01
Bridge superstructure and overall	± 0.01	± 0.01
Environmental Control Limits	± 1.00	-----
Clearing and grubbing limits	± 1.00	-----
Right of Way Limits	± 0.02	-----
Roadway subgrade finish stakes	± 0.10	meet tolerance of succeeding layer
Roadway finish grade stakes	± 0.04	meet tolerance of succeeding layer
Signals and electrical	± 0.05	± 0.02
Striping	± 0.08	-----
Paving reference line	± 0.04	± 0.01

Coordinate the survey tolerances of any items not listed above with the Engineer. Tolerances given above are subordinate to any tolerances listed in other specifications.

D. Staking limits:

1. Stake clearing limits on both sides of centerline at each established station. Locate the clearing limit on the ground as shown by the cut and fill limits on the plans.

2. Stake right of way limits every 50 ft maximum on tangents, every 25 ft maximum on curves and at all right of way breaks. If staking distance is affected by line of sight, reduce the distance.
3. Stake environmental control limits on both sides of centerline at each established station. 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. Stake environmental control limits every 50 ft and every 25 ft where environmental or silt fence is required.

E. Furnish reference stakes for all slope stakes and stakes used for setting items for work.
1. Maintain the reference stakes for the duration of the project until the Engineer approves removal.
2. 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.
3. Establish slope stakes in the field as the actual point of intersection of the design slope with the natural ground line.
4. Set slope stake references outside the clearing limits.
5. Include all reference point and slope stake information on the reference stakes.

F. Record the vertical distance from the reference point (RP) to the construction grade on the cross section guard stakes after the slope staking is completed at a minimum horizontal distance of 10 ft outside the clearing limits or at right of way.

G. Setting grade finishing stakes:
1. For 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 15 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 all ditches to be paved.
3. Maximum spacing between stakes along the alignment: 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.

H. The following Advanced Traffic Management System (ATMS) As-Built requirements apply to all ATMS device installations, that include but are not limited to Ramp Meters, Closed Circuit Television (CCTV), Variable Message Sign (VMS), Roadway Weather Information System - Environmental Sensor Station (RWIS-ESS), Weigh In Motion (WIM), and Fiber Optic Communication Systems.

1. Department:
   a. Provide project design files to Contractor in MicroStation format.
2. Contractor:
   a. Carefully document all changes and update all files to accurately represent the system as-built conditions.
   b. Plot three sets of the updated files on 11 inch x 17 inch bond paper and submit the plots to the Engineer for review and approval.
3. As-built drawings will not be considered complete until the Engineer has given formal approval of the plots and design files.
4. Include the following in as-built drawings:
   a. Site plans with distances.
   b. Final cabinet configuration, including wiring schematic.
   c. Pin-outs for any custom connectors.
   d. Laminated copy of the detector layout for the site, consisting of site map and including detector numbering, locations, and input file designation.
   e. GPS coordinates for all junction boxes, conduit runs at 250 ft intervals, and ATMS devices. Include latitude, longitude, and elevation in WGS 84 format to nine decimal place precision (XXX.XXXXXXX) in coordinates.

3.6 CONCRETE PAVING

A. Develop a method of horizontal and vertical control for the placement of concrete pavement.

1. Utilize laser, wire, or string line, for example, to maintain horizontal and vertical control.
2. Maximum spacing: 50 ft.
3. Set control on both sides of roadway.

B. Stake concrete joint and station stamp locations.

3.7 DRAINAGE STRUCTURES

A. Stake drainage structures to fit field conditions and in coordination with the Engineer. The location of the structures may differ from the plans.
   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 any intermediate point as needed or directed
      c. Flow line grade of the pipe
      d. Station
   7. For storm sewers and waterlines provide a reference at a maximum spacing of 50 ft. Reference inverts of pipe at all manholes.

3.8 BRIDGES

A. Set a minimum of 3 horizontal and vertical control reference points to be used for surveying all bridge substructure and superstructure components, including but not limited to pile locations and cutoffs, line and grade for abutments and bents, beam seats, anchor bolts, and screed grades.

B. Set intermediate slope stakes at bridge abutments to establish transitions. Place finish grade stakes on the centerline of abutment bearing and at the top of slope of all bridge berms. 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. Establish and reference the centerline, back of parapet, 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. 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 curved sections unless otherwise approved.

B. Obtain Engineer's approval and field verification of staking prior to installation.

3.12 EXISTING SURVEY MONUMENTS

A. Locate and reference all private and public land survey monuments that may be destroyed by project construction activities prior to disturbing those existing monuments and under the direction of a surveyor licensed in the State of Utah.

B. Complete referencing and reestablishing those existing monuments at no cost to the Department and before project completion.

C. Reference and reestablish the monuments created by the county surveyor.
   1. Notify the county surveyor at least 30 days prior to the destruction of any monument.
   2. Coordinate the reestablishment of section corner and quarter corner monuments with the county surveyor.
   3. Submit drawings and notes showing references to section corners and quarter corners to the Engineer.

D. The Department pays for the additional work under the Directed Survey item if a monument is found during construction but is not shown on the contract plans and must be reset.

3.13 RETAINING WALLS

A. Set horizontal and vertical control and reference points. Establish and reference the centerline offsets for the walls, radius points, and the beginning and ending wall locations as shown on the plans.

B. Stake retaining wall vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.14 PAVEMENT MARKING

A. Layout all temporary and permanent pavement markings per Section 02765.

3.15 CLEANUP

A. Remove and dispose of all flagging, lath, stakes and other staking material after the project is complete.
   1. Place references for traffic striping a minimum of 150 ft apart on tangents and a minimum of 50 ft on curves.

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. Stake crossings or potential points of conflict between facilities to give proper horizontal and vertical control for the relocation. Schedule this survey work with the utility companies to minimize delays and disruption of survey stakes. Replace all disturbed stakes as necessary to facilitate the relocations. The Contractor is responsible for costs incurred to relocate any utility more than once due to inaccurate or incomplete staking.

END OF SECTION

SECTION 01741

FINAL CLEANUP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish and clean 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 drag, push, or scrape along or across the final pavement surface.

B. Only use equipment with pneumatic tires on the final pavement surface.

C. Determine the Safety Zone using the current AASHTO Roadside Design Guide.
   1. No protrusions or depressions greater than 3 inches are allowed within the clear zone such as rocks, boulders, ridges, stumps, etc.
   2. Remove trees and provide proper sight distance.

D. Clean all debris and obstructions and dispose of material removed within drainage ditches.

E. Cover large rocks or boulders with fine material from roadway excavation or borrow on fill slopes. Clean up of large rocks and boulders may not be required on slopes steeper than 3:1 beyond the clear zone.

F. Do not undercut the slope on cut slopes. Remove all overhanging rocks. Solid ledge rock or partially buried boulders 0.33 yd^3 or more may be left in place on slopes steeper than 4:1 beyond the clear zone.

G. Within borrow and local material source sites, Refer to Section 01455.

H. Within right-of-way limits:
   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.

I. Staging and office sites:
   1. Clean up and finish as described for finishing local material source sites including seeding and mulching. Refer to Section 01455.

END OF SECTION

SECTION 01891

MOVE STREET SIGNS AND MAILBOX ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Move or reset street signs.

B. Move or reconstruct existing mailbox supports.

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. ASTM A 36: Carbon Structural Steel

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 CONCRETE

A. Class B, refer to Section 03055

B. Substitute higher class of concrete if desired.

2.2 WOOD POSTS FOR MAILBOX AND SIGN

A. Refer to Section 06055

2.3 MAILBOX MOUNTING HARDWARE

A. Shelf, platform, and bracket.

B. Zinc plated bolts, washers, and nuts.

C. ASTM A 36M, and AASHTO M 111. Refer to GW Series Standard Drawings.

PART 3 EXECUTION

3.1 MOVE STREET SIGN

A. Maintain existing signs until construction requires removal. Coordinate with Engineer 24 hours in advance of removing any sign.

B. Relocate existing street signs as indicated or as directed by the Engineer.

C. Remove concrete from existing posts where posts are to be reused.

D. Reset post in 8.0-inch diameter concrete base. Keep the box within ⅛ inch of the finished grade.

E. Fill and compact hole left by removing sign post. Compact to density of adjacent material.

3.2 MOVE MAILBOX

A. Furnish and install new posts, shelf, and brace, firmly attaching boxes to the support. Refer to GW Series Standard Drawings.

B. Repair or replace mailboxes damaged during construction.

C. Install temporary posts and mailboxes if required, then remove.

END OF SECTION

SECTION 01892

RECONSTRUCT CATCH BASIN, CLEANOUT, METER, VALVE, MANHOLE, AND MONUMENT BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reconstruct catch basin, cleanout, meter, valve, manhole, and monument boxes to meet the grade of the adjacent surfaces.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. AASHTO M 105: Grey Iron Castings.

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 CONCRETE

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

2.2 EXTENSION RINGS

A. Cast iron. AASHTO M 105

PART 3 EXECUTION

3.1 RAISE BOXES

A. Contractor options:
   1. Remove the cover and frame and raise the box using concrete.
   2. Raise the box using precast concrete manhole sections.
   3. Raise the frame and cover using adjustable extension rings.

B. Set box so that all corners are within ⅛ inch lower than finished grade of roadway.

3.2 LOWER BOXES

A. Remove the frame and break off the existing walls.

B. Use concrete to provide a new seat for the frame.

C. Set box so that all corners are within ⅛ inch lower than finished grade of roadway.

3.3 PAVEMENT REPAIR

A. Place and compact approved material below the pavement structure.

B. Place and consolidate portland cement concrete the full depth of the pavement to match the existing pavement surface.

END OF SECTION

SECTION 02056

EMBANKMENT, BORROW, AND BACKFILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for construction of embankment, backfill, and bridge approach embankments.

1.2 RELATED SECTIONS

A. Section 02231: Site Clearing and Grubbing

B. Section 02317: Structural Excavation

C. Section 02912: Topsoil

D. 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 Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit the following before delivering material to the project:
   1. Supplier and source of materials

2. Gradation analysis AASHTO T 27 and T 11
3. Soil classification when applicable 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.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is in accordance with UDOT Minimum Sampling and Testing Requirements.

B. Engineer reserves the right to select and test material randomly from any location at the construction site.

C. Density Requirement: Acceptance is on a lot-by-lot basis when average density is not less than 96 percent of maximum laboratory density and no single determination is 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.

D. Remove any material found defective and replace with acceptable material at no additional cost to the Department.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials free of contamination from chemical or petroleum products for embankment and backfill placements. Materials may include recycled portland cement concrete.

2.2 BORROW

A. Classifications A-1-a through A-4. Meet AASHTO M 145

2.3 GRANULAR BORROW

A. Classification A-1-a. Meet AASHTO M 145

B. Non-plastic, well-graded, 3-inch maximum

2.4 GRANULAR BACKFILL BORROW

A. Classification A-1-a. Meet AASHTO M 145

B. Non-plastic, well-graded, 2-inch maximum

2.5 EMBANKMENT FOR BRIDGE

A. Granular Borrow

2.6 FREE DRAINING GRANULAR BACKFILL

A. Meet the following gradation:

Table 1

Free Draining Granular Backfill Gradation	
Sieve Size	**Percent Passing**
1½ inch	100
1 inch	95 to 100
½ inch	25 to 60
No. 4	0 to 10

2.7 FLOWABLE FILL

A. Refer to Section 03575

PART 3 EXECUTION

3.1 PREPARATION

A. Complete clearing and grubbing and stripping and stockpiling topsoil before placing embankment. Refer to Sections 02231 and 02912.

B. Excavate and dispose of unsuitable material as directed by the Engineer.

3.2 EMBANKMENT PLACEMENT

A. Place roadway excavation or borrow 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 to at least 90 percent of maximum laboratory density when the embankment height is 6 ft or less and the underlying ground consists of loose material.

C. Break and scarify all underlying road surfaces in so that pieces do not exceed 3 ft^2.

D. Maintain drainage.
   1. Grade and maintain the roadway to ensure adequate drainage.

2. Maintain pipe culverts and drainage ditches, or provide temporary facilities when interrupting irrigation systems, sewer, underdrainage, etc.

E. Place an initial layer to act as a working platform over soft, wet ground when approved by the Engineer.
   1. Density specifications do not apply to the working platform.
   2. Meet density requirements for embankment placed above the working platform.

F. The Engineer inspects and accepts the working platform or foundation before embankment is placed.

G. Spread embankment materials uniformly in layers not exceeding 1 ft (uncompacted depth) and compact to an average of 96 percent maximum laboratory density before placing the next layer. Reduce the lift thickness if tests show unsatisfactory density.

H. Finish subgrade surface within ±0.1 ft of line and grade.

I. Do not use rock or pavement materials over 3 ft in any dimension. Distribute so space exists for placing and compacting embankment material between large rocks or pavement materials.

J. Do not place large rock within 1 ft of the subgrade surface. Do not allow rocks to protrude above the subgrade surface.

K. Do not use compacting equipment that causes shear failure in the embankment.

3.3 GRANULAR BORROW AND BACKFILL PLACEMENT

A. Finish granular borrow surface within ±0.1 ft of line and grade.

B. Compact borrow and backfill material in 6-inch layers to a 96 percent density.

C. Structural Backfill Placement includes bridges, foundation, box culverts, pipe culverts, drains and other structures.
   1. Place suitable backfill material in structural backfill sections. Refer to Section 02317.
      a. Use granular backfill borrow when specified.
   2. Use appropriate compaction equipment adjacent to abutments, backwalls, approach slabs, wing walls, retaining walls, and other structures.

D. Free Draining Granular Backfill
   1. Excavate a trench 3 inches below the underdrain pipe flow-line. Widen to 2 ft plus the outside diameter of the underdrain pipe.
   2. Place free draining granular backfill in the trench and compact the bottom 3 inches with two passes of a vibratory roller.
   3. Back fill to 12 inches above top of pipe with free draining granular backfill.

3.4 EMBANKMENT FOR BRIDGE PLACEMENT

A. Construct approach embankments from the original existing ground up with the specified material to the limits defined herein and in accordance with DD series Standard Drawings.
   1. Approach Embankments
      a) Place embankment beneath the bridge except riprap or other specified 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 placed for embankment on the inside of abutments.
      c) Use the specified 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.

B. Over-excavate unsuitable material such as soft, springy, organic, or otherwise yielding material at natural ground level as directed by the Engineer.

C. The Engineer inspects and accepts the working platform or foundation before embankment is placed.

D. Spread embankment materials uniformly in layers not exceeding 1 ft (uncompacted depth) and compact to an average of 96 percent maximum laboratory density before placing the next layer. Reduce the lift thickness if tests show unsatisfactory density.

E. Finish surface within ±0.1 ft of line and grade.

3.5 LIMITATIONS

A. Requirements when working during freezing or snowy conditions:
   1. Do not place embankment on frozen or snow-covered areas.
   2. Do not deliver or use frozen material in embankments.
   3. Remove snow and frozen material from embankments, foundations, and borrow areas, and furnish embankment material that can be compacted to the specified density.
   4. Remove waste and replace frozen embankment material at no additional cost to the Department.
   5. Measure wasted material and provide quantities to the Engineer.

END OF SECTION

SECTION 02075

GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing geotextiles of the types shown on the drawings, and at other locations as directed by the Engineer.

1.2 RELATED SECTIONS

A. Section 01571: Environmental Controls.

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specifications for Highway Applications

B. UDOT Minimum Sampling and Testing Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit prior to use: Manufacturer's certificate that each fabric complies with requirements of this Section.

1.6 SAMPLING AND TESTING

A. Follow UDOT Minimum Sampling and Testing Guide requirements.

B. Test each individual lot of geotextile prior to shipment and send testing reports with the shipment to the job site. Clearly label all rolls as part of the same production run and certify they meet all material requirements.

1.7 PACKAGING, SHIPPING, AND STORING

A. Protect the geotextile from direct sunlight, chemicals, mud, dirt and debris during shipment and storage. Replace at the Contractor's sole expense, any geotextile damaged or deteriorated during shipping, storage or construction.

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
      c. Orange UDOT Certification sticker

1.8 ACCEPTANCE

A. Department rejects geotextile at installation if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transport, handling, or storage.

B. Non-compliance with UDOT Minimum Sampling and Testing Guide requirements will be a basis for rejection.

PART 2 PRODUCTS

2.1 SILT FENCE GEOTEXTILE

A. Refer to Section 01571.

2.2 EROSION CONTROL GEOTEXTILE

A. Furnish as specified in AASHTO M 288.

2.3 DRAINAGE GEOTEXTILE

A. Furnish non-woven drainage geotextile as specified in AASHTO M 288 with in-situ soil designations as shown on the drawings or as indicated by the Engineer.

B. Notify Engineer if soil conditions are different than shown on the drawings.

2.4 SEPARATION GEOTEXTILE

A. Furnish Class II fabric as specified in AASHTO M 288, with Apparent Opening Size of 0.22 mm maximum average roll value.

2.5 STABILIZATION GEOTEXTILE

A. Furnish Class II fabric as specified in AASHTO M 288 with Apparent Opening Size of 0.25 mm maximum average roll value.

2.6 WEED BARRIER GEOTEXTILE

A. Furnish non-woven weed barrier geotextile with elongation less than 50 percent for all weed barrier applications as specified in AASHTO M 288.

2.7 POSTS FOR SILT FENCE

A. Refer to Section 01571.

PART 3 EXECUTION

3.1 GENERAL

A. Place geotextile on areas that are smooth, and free of projections or depressions. Do not drag the geotextile across the subgrade. 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. 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. Use a minimum 6 inches thick cover layer, or twice the maximum aggregate size, whichever is thicker. 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 the lesser. Do not turning 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 on the drawings.

B. Overlap the geotextile a minimum of 2 feet at all longitudinal and transverse joints or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8, Sewing for sewing requirements.

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. Pins, usually 18 inches in length may be helpful in securing the geotextile during installation.

G. Repair: Place patch over damaged area and extend 3 ft beyond the perimeter of the tear or damage.

3.4 INSTALL DRAINAGE GEOTEXTILE FOR SUBSURFACE DRAINAGE

A. Excavate trench to size and depth indicated.

B. Cut geotextile to width required and place in trench. Prevent damage to geotextile.

C. Overlap geotextile 12 inches or the full width of the trench, whichever is less, at the top of the trench.

D. Overlap successive sheets of geotextile a minimum of 12 inches in the direction of flow.

E. Place fill beginning with the sheets overlapped above subsequent sheets to hold geotextile in place.

F. Repair any damage to geotextile by placing patches extending 3 feet in all directions beyond the damaged area.

3.5 INSTALL SEPARATION GEOTEXTILE

A. Install for pavement sections or other applications at locations shown on the drawings.

B. Overlap the geotextile a minimum of 1 foot at all longitudinal and transverse joints or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8, Sewing for sewing requirements.

C. Repair: Place patch over damaged area and extend 3 feet 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 on the drawings, or as designated by the Engineer.

B. Overlap the geotextile a minimum of 2 feet at all longitudinal and transverse joints, or sew the geotextile unless otherwise specified. Refer to this Section, article 3.8, Sewing for sewing requirements.

C. Overlap each sheet over the next downhill sheet for placement on slopes.

D. Repair: Place patch over damaged area and extend 3 feet 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. Roll geotextile over soil and cut an “X” for each plant hole if placing over a new bed. Fold excess geotextile under and cover with specified landscaping materials.

B. Surface Cover: Provide a minimum of 4 inches of cover on all areas on the geotextile unless otherwise specified by Engineer. Increase thickness of cover material over geotextile up to three times the diameter of the largest rock material based on Engineer’s recommendations if using large landscape rock. Do not leave any portion of geotextile exposed to direct sunlight.

C. Repair: Repair immediately if damaged. Remove the damaged area plus an additional 3 feet and apply geotextile patch.

D. Maintenance: Maintain surfaces and supply additional landscape materials where necessary including areas affected by erosion.

3.8 SEW

A. Perform sewing or seaming as specified in AASHTO M 288, Section A1-4.

END OF SECTION

SECTION 02078

ASPHALT OVERLAY FABRIC

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

A. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. UDOT Minimum Sampling and Testing Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

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.
   4. UDOT Certification Sticker.

1.7 PROTECTION

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

B. Replace at the Contractor's expense, fabric damaged or deteriorated during shipping, storage, or construction.

PART 2 PRODUCTS

2.1 ASPHALT OVERLAY FABRIC

A. Use needle-punched non-woven fabric constructed exclusively of manmade polymeric fibers.
   1. Resistant to rotting, mildew, insects, chemicals and ultraviolet (UV) light.
   2. Meet the following additional minimum average roll requirements when sampled and tested with the methods specified.
   3. Refer to AASHTO M 288, Table 7.

2.2 SOURCE QUALITY CONTROL

A. Meet UDOT Minimum Sampling and Testing Requirements.

B. Perform tests prior to shipment for each individual shipment and lot of fabric.

C. Include testing reports and Certificate of Compliance with the shipment to the job- site.

D. Basis for Rejection: In accordance with UDOT Minimum Sampling and Testing Guide 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 0.25 inch with a sand and asphalt emulsion filler material.

B. Apply tack coat to the prepared surface at a rate of 0.25 gallon to 0.30 gallon per square yard as approved by the Engineer. Refer to Section 02748.
   1. Additional tack coat is required on overlapped areas.
   2. The Engineer considers 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. Materials and procedures for installing water meters as indicated on the plans.

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's specifications.

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 WATER METERS AND ACCESSORIES

A. Meet the American Water Works Association's specifications.

B. Meter Yoke: 21 inches high (minimum) copper setter as manufactured by Ford or equal.

C. Meter Box:
1. Rigid PVC pipe meeting ASTM D 1784.
2. 18 inches in diameter by 3 feet long.
3. Free standing crush factor of 3000 pounds.

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 inches and smaller.
   2. Ductile iron class 51 for sizes larger than 2 inches.

F. Aggregate: meet specifications for Free Draining Granular Backfill Borrow. Refer to Section 02056.

G. Corporation Stop and Service Saddle Clamp: Supplied by the water system authority unless otherwise noted on plans.

H. Joint Seal Tape (Teflon).

PART 3 EXECUTION

3.1 PREPARATION

A. Obtain all permits associated with the connection and installation.

B. Coordinate with the water system authority the installation of items not performed by own forces.

C. Before trenching:
   1. Stake water meter.
   2. Have utility companies locate and mark their lines.

D. 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. Water system authority products and installation specifications supersede those listed below.

B. Excavate a trench from the main supply line to the water meter location at the depth determined by local authorities.

C. Install water meter according to manufacturer's specifications.
   1. Place a 6 inches deep free draining granular backfill borrow sump in the bottom of the meter box.

D. Bed all pipe 2 inches minimum surrounding the pipe with sand.

E. 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 noted.

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 all 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. Remove, dispose of, or salvage buildings, fences, structures, pavements, curb, gutter, driveways and approaches, sidewalk and similar hard surfaces, abandoned pipelines or utility items and other obstructions that interfere with construction on or off the site including, but not limited to, foundations, bridges, culverts, guardrail, concrete work, septic tanks, trees, etc.

B. Salvage as specified, or dispose of in an approved manner.

1.2 RELATED SECTIONS

A. Section 00727: Control of Work

B. Section 01355: Environmental Protection

C. Section 02056: Embankment, Borrow, and Backfill

D. Section 02705: Pavement Cutting

E. Section 03055: Portland Cement Concrete

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

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 Concrete. Refer to Section 03055.

2.2 COMMON FILL

A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with Engineer.

B. Coordinate utility location in accordance with Section 00727.
   1. Locate and protect all active utilities.
   2. Before beginning work:
      a. Notify Engineer.
      b. Notify all affected utilities.
      c. Blue Stake the area.

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. Plug disconnected storm drains or sewer lines near the right-of-way line with a watertight concrete plug extending at least 2 ft into the remaining pipe.

F. Remove existing septic tanks, cesspools, leach lines, etc.

G. All materials not designated for use or salvage become the property of the Contractor unless owned by a utility company.

H. Excavate all material necessary to permit removal of structure.

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. Material items not included in the bid proposal will be considered incidental to the work.

3.3 REMOVAL AND DISPOSAL

A. Remove and dispose of all material promptly using methods acceptable to the Engineer and in accordance with all applicable rules and regulations.
   1. Include all excavation, removal, transportation, and disposal costs in the item of work.

B. Repair any damage to adjacent area at no additional cost to Department.

C. Remove all concrete to at least 2 ft below the finished grade, or 2 ft below the natural ground surface, whichever is lower.

D. Obtain all required permits and provide an environmentally safe area for disposal of removed items. Refer to Section 01355.

E. Dispose of removed obstructions at a site secured by the Contractor. Furnish the Engineer with a copy of the disposal permits or agreements.

3.4 BUILDING, BASEMENT, AND FOUNDATION DEMOLITION

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 any 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 over 3 ft^2 in areas to remain in place. Remove and dispose of pieces over 3 ft^2.

3.5 BRIDGE AND BOX CULVERT DEMOLITION

A. Arrange detours for traffic flow according to traffic control plans.

B. Excavate all material necessary to permit removing structure.

C. Remove structure so that no remaining portion is closer than 3 ft to any watercourse or closer than 2 ft to the subgrade and embankment surface or within 2 ft of the natural ground surface.

D. Remove all structures that will interfere with proposed construction.

E. Complete blasting or other removal operations of existing structure that may damage new construction before placing the new work.

3.6 REMOVE CONCRETE SLOPE PROTECTION

A. Remove portions of the existing slope protection and the cutoff wall where required.

B. Obtain the Engineer's approval of the concrete slope protection removal limits.

C. Saw cut the existing slope protection to full depth.

D. Do not damage the portions of concrete slope protection that are to remain.

E. Dispose of the removed material in an environmentally safe area.

3.7 MANHOLE, CLEANOUT, DIVERSION BOX, AND CATCH BASIN REMOVAL

A. Maintain satisfactory by-pass service during construction operations.

B. Plug unused sewers with a 2 ft long concrete plug.

3.8 CATTLE GUARD REMOVAL

A. Remove the cattle guard to at least 2 ft below the subgrade surface.

B. Excess materials become the Contractor's property unless otherwise designated.

3.9 SEPTIC TANK AND UNDERGROUND TANK REMOVAL

A. Empty and dispose of tank contents in accordance with 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 over 3 ft^2 in area.

3.10 BURIED FUEL TANK DEMOLITION

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with 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.

3.11 GUARDRAIL REMOVAL

A. Remove and dispose of guardrail, posts, hardware, anchor assemblies, terminal assemblies, and attached posts, signs, and delineators.

B. Remove steel posts to a minimum of 8 inches below the subgrade surface or finished ground lines.

3.12 FENCE REMOVAL

A. Prevent people or livestock from entering work site from adjacent properties during removal and installation procedures.

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.

3.13 RAILROAD TRACK REMOVAL

A. Remove all rails, ties, paving, track encasement, and other appurtenances.

B. Leave crushed stone or gravel ballast. Grade as required.

3.14 TREE REMOVAL

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 a minimum depth of 2 ft below the finished ground level and within a 2 ft radius of the stump.

4. When there is no bid item included in the proposal for Tree Removal:
   a. This work is considered incidental to other items of work and no separate measurement or payment will be made.
   b. Include all costs in other items of work.

B. Trees removed with a circumference 20 inches or less measured at 2 ft above existing ground are considered incidental construction.

3.15 CONCRETE HEADWALL REMOVAL

A. Remove headwalls where designated.

B. Replace pipes or structural plate pipes damaged while removing headwall at no additional cost to the Department.

3.16 UTILITY POLE REMOVAL

A. Remove pole and all appurtenances.

B. Remove foundation to at least 2 ft below subgrade or natural ground.

3.17 PIPE CULVERT REMOVAL

A. Excavate all material necessary to permit removing pipe culvert, end sections, headwalls, etc.

B. Plugs:
   1. Cut existing pipe culvert 2 ft inside the Department's right-of-way, and abandon culvert located on private property.
   2. Plug disconnected pipelines near the right-of-way line with a water-tight concrete plug extending into the remaining pipe at least 2 ft.

C. Seal openings in walls of remaining manholes or catch basins with watertight concrete plug.

3.18 PAVEMENT REMOVAL

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.

3.19 OBLITERATE ROAD

A. Break up pavement into pieces not over 1 ft^2 in area. 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. Cover with at least 1 ft of suitable backfill material.

3.20 CONCRETE SIDEWALK AND CONCRETE DRIVEWAY REMOVAL

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.

C. Do not damage concrete designated to remain.

3.21 CONCRETE CURB, CONCRETE CURB AND GUTTER, RAISED ISLAND, AND BITUMINOUS CURB REMOVAL

A. Remove curb, curb and gutter, gutters, 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.

3.22 SALVAGE

A. Salvage designated equipment and materials.

B. All other materials become the property of the Contractor unless otherwise noted.

END OF SECTION

SECTION 02225

ASPHALT SURFACING REMOVAL (STRUCTURES)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove existing asphalt surfacing materials from deck and approach slabs.

1.2 RELATED SECTIONS

A. Section 02231: Clearing and Grubbing.

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 or 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. Remove asphalt as specified.

B. Remove any existing waterproofing membrane from the deck and concrete approach slabs.

3.2 PARTIAL DEPTH REMOVAL

A. Remove a uniform thickness of asphalt from the deck and approach slabs without damaging the underlying asphalt, waterproofing membrane, or concrete surfaces.
   1. Refer to the plans for the asphalt surfacing removal depth.
   2. Allow no traffic on the asphalt surface after partial depth removal. Return traffic only after placing the final surfacing.

B. Use equipment that weighs less than 22 tons.

3.3 ASPHALT DISPOSAL

A. Refer to Section 02231 for asphalt disposal.

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 Protection

B. Section 01571: 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, and other material under the ground surface.

1.5 SUBMITTALS **Not Used**

1.6 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for “Site Clearing and Grubbing”
   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 Engineer the vegetation or objects to be removed.

B. Review work procedures with 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. 2.0 ft or more above the natural ground.
   2. At least 2.0 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. 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. 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, and at no additional cost to the Department.
   2. Furnish the Engineer with copies of the disposal permits or agreements.

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 a minimum of 2.0 ft of earth and grade to drain properly at no additional cost to the Department.
   4. Reduce wood to chips a maximum of ½ inch thick for mulching cut and fill slopes. 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 02312

GRADING FOR LANDSCAPES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for landscape grading.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02912: Topsoil

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 QUALITY ASSURANCE

A. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during backfilling. Work closely with Engineer particularly when grading and constructing berms, channels, or other aesthetic structures.

1.7 PAYMENT PROCEDURES

A. When there is no bid item included in the proposal for Grading for Landscapes:
   1. This work is considered incidental to other items of work and no separate measurement or payment will be made. Include all costs in other items of work.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Provide soils that comply with Section 02056 for fill areas that are to be landscaped.

B. Topsoil: Refer to Section 02912.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required line, levels, contours, and datum.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter, and other features.

3.3 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent freestanding surface water.

B. Leave borrow areas clean and neat.

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 Protection

D. Section 01571: 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) Standards

B. UOSH Construction Standards

1.4 DEFINITIONS

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

1.5 SUBMITTALS

A. Submit proposed method of blasting, delay pattern, explosive types, and type of blasting mat cover.

1.6 ACCEPTANCE AND PAYMENT PROCEDURES

A. Payment is plan quantity by the cubic yard. If staked quantities differ by 5 percent or less make no adjustment to plan quantities.

B. Notify the Engineer in writing 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 in accordance with 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. 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: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

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: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

B. Mark all storage places clearly.

3.3 TOPSOIL

A. Remove topsoil in accordance with 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 irrigation systems, sewer, underdrainage, etc.

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. Scarify to an 8-inch depth and compact to at least 96 percent of maximum laboratory density when necessary to obtain compaction. Refer to Section 02056.

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 of depth greater than 1 ft below subgrade will not be measured or paid for.

3.7 ROCK REMOVAL – EXPLOSIVE METHOD

A. Comply with UOSH Constructions Standards Chapter U rules and regulations.

B. Comply with NFPA 495: Code for the Manufacture, Transportation, Storage, and Use of Explosive Materials.

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 according to plans.

C. Dispose of pavement using methods acceptable to the Engineer in accordance with 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. Furnish the Engineer with copies of the disposal permits, agreements, or both.

END OF SECTION

SECTION 02317

STRUCTURAL EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate and backfill for constructing bridges, foundations, box culverts, pipe culverts, drains, and other structures.

1.2 RELATED SECTIONS

A. Section 00820: Legal Relations and Responsibility to the Public

B. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PAYMENT PROCEDURES

A. This work is considered incidental to other items and no separate measurement or payment will be made except as described in this Section article 3.3, paragraph B for over-excavation directed by the Engineer, necessary import of suitable backfill material directed by the Engineer, or both.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Use the plan set for the structure design. The Engineer may order design changes in writing based upon differing site conditions.

B. Provide a cofferdam for underwater work. Remove all cofferdams, sheeting, and bracing when no longer needed.

3.2 EXCAVATION

A. Comply with all applicable regulations when excavating and trenching. Refer to Section 00820.

B. Excavate rock and other hard strata to design elevation and dimensions.
   1. Clean and cut to a firm surface as shown in the plans. 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. Excavate material unsuitable for the structure foundation to at least 1 ft below the design elevation.
   2. Excavate and waste unsuitable material to the depth directed.

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 as directed by the Engineer.

3.3 BACKFILL AND COMPACTION

A. Refer to Section 02056.

B. Excavate unsuitable material and backfill:
   1. Cost of over-excavation is paid as extra work when directed by the Engineer.
   2. Use imported suitable backfill material or granular backfill borrow when specified suitable backfill material is not available from roadway excavation. Imported backfill material cost is paid as extra work and may include transportation or freight costs. Placement of imported backfill material is at no additional expense to the Department.

END OF SECTION

SECTION 02318

DITCH EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for 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 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 in the plans.

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 SMALL DITCH EXCAVATION

A. Form the ditch as shown in the plans.

B. Place and compact excavated material in embankments as defined in 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

WIRE ENCLOSED RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for wire enclosed riprap.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02075: Geotextiles

C. Section 02316: Roadway Excavation

D. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. AASHTO T 96: Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine

C. ASTM A 116: Metallic-Coated (Galvanized) Steel Woven Wire Fence Fabric

D. ASTM A 641: Zinc Coated (Galvanized) Carbon Steel Wire

1.4 DEFINITIONS

A. Connecting wires: Internal galvanized wires used to prevent the walls of the deeper basket units from bulging.

B. Diaphragms: The internal galvanized wire mesh partitions that divide the baskets into smaller cells.

C. Hop Rigs: Heavy wire elements. Precut and performed to fit application tools and serve a similar function to lacing or binding wire.

D. Lacing or binding wire: The galvanized wire used to assemble and join the individual basket modules to each other to form a monolithic structural unit.

E. Reinforcing wires: The thicker galvanized wires incorporated into the wire mesh faces during fabrication of the baskets.

F. Selvedges of the basket structures: The galvanized thicker perimeter and edge galvanized wires to which the wire mesh faces of the baskets are securely tied.

G. Wire enclosed riprap: Modular galvanized steel wire mesh box-shaped baskets of varying sizes. Baskets filled with stone on site.

1.5 SUBMITTALS

A. Manufacturer's product data including typical construction details and procedures.

1.6 QUALITY ASSURANCE

A. Construct to the line and grade as shown in the plans.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stone:
1. Sound, clean, angular, well-graded rock, free of seams or cracks.
2. No stone greater than 10 inches in size.
3. Retain 95 percent or more of the stone on a square screen having openings whose areas are equivalent to those areas presented by the unstretched or deformed wire mesh from which the basket modules are fabricated.
4. Maximum 40 percent wear. Refer to ASTM C 535.
5. Maximum 16 percent weighted loss when subjected to five cycles of sodium sulfate. Refer to AASHTO T 96.

B. Wire:
Do not use less than the following minimum gauges:
1. Use wire that meets ASTM A 641, Class 3.
2. Selvage wires: 9 gauge
3. Lacing wire: 13 gauge
4. Hog rings: 9 gauge
5. Connecting wires: 13 gauge

6. Reinforcing wires: 13 gauge
7. Finish a wire coated with polyvinyl chloride (PVC) with a nominal thickness of 0.022 inches and nowhere less than 0.015 inches over the required galvanization when the pH of the liquid or of the native soil in contact is greater than 10.

C. Wire Mesh:
1. Do not use less than 11 gauge wire.
2. Furnish non-raveling wire mesh that maintains its overall support function when a single wire in a section of mesh is damaged or cut.
3. Protect the wire elements with a galvanized coating of not less than 0.85 ounces per square foot of wire surface. ASTM A 116, type A, ASTM A 641, class 3
4. Do not use wire mesh with openings larger than 4 inches.
5. Must be capable of stretching in length a minimum of 10 percent without reducing the tensile strength of the individual wire strands making up the mesh to values less than those for similar wire, one gauge smaller in diameter.

D. Anchor Rods:
1. Provide ¾ inch minimum diameter steel rods; reinforcing bars allowed following Section 03211.
2. Use 3 ft long anchor rods with a 3 inch hook bend or a 6 inch "T" welded to the top of the rod.

E. Accessories:
1. Furnish Stabilization/Separation Geotextile as specified in AASHTO M 288 and as approved by the Engineer when required in the plans.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials.

B. Remove unacceptable material to a 1 ft depth. Refer to Section 02316.

C. Replace with granular borrow material bringing the grade to the base of the wire enclosed riprap structure. Refer to Section 02056.

D. Provide a firm foundation by excavating to a dressed uniform surface conforming to the lines and grades shown in the plans and the finished depth of the wire baskets.

E. Compact with two passes of a vibratory roller on 3:1 or flatter slopes. Refer to Section 02056.

F. Do not over excavate or disturb compacted foundations or undisturbed soils outside of the required lines and grades shown on the plans. Secure approval from the Engineer before backfilling or installing geotextiles.

G. Install required geotextile fabric when indicated on the plans. Refer to Section 02075.

3.2 PLACING WIRE ENCLOSED RIPRAP

A. Install all proprietary materials according to manufacturer's recommendations.

B. Assemble individual baskets for all revetment designs in such a manner that the failure and loss of stone fill from any single basket will not cause the failure and loss of stone fill in the adjoining baskets.

C. Assemble the wire mesh bases, lid, ends, and sides into a single unit.
   1. Securely selvedge all discontinuous perimeter edges with continuous lacing wire.
   2. Tie all untied edges with binding wire. Tightly loop binding wire around every other mesh opening along the seams in such a manner that single and double loops are alternated.
   3. Connect all common edges of face elements so that the strength and flexibility at the connecting edge is at least equal to that of the mesh faces of the boxes.
   4. The joints formed by tying must have the same strength as the body mesh.

D. Place a diaphragm of the same mesh and gauge as the body of the wire basket module when the length of the basket exceeds 1½ times its horizontal width. Divide the diaphragms into cells whose lengths do not exceed the horizontal width of the basket. Secure the diaphragm in the proper position to the base section so that no additional tying will be required at this point in assembly.

E. Stretch the baskets if needed only after the empty baskets have been placed into position as indicated in the contract drawings and each empty wire basket module is complete and securely tied to the adjoining basket modules along with vertical reinforced edges and the top selvedges.

F. Place the stone in the wire baskets according to the manufacturer's recommendations.
   1. Protect wire from being broken.

2. Protect sides and ends from being crushed and kinked. If necessary use a loading frame to support the wire fabric while placing rocks.
3. Hand place stone fill on exposed vertical faces so that a satisfactory face graduation and loss of smaller stone fill through mesh openings.

G. Insert connecting wires in the cells of baskets deeper than one foot in the following manner:
1. Baskets of three feet in depth: uniformly fill adjacent cells first with stone to a height of 12 inches.
2. Place one connecting wire in each direction along the center and secure it to the opposite faces of each cell by looping it around two mesh openings. Twist the ends to the wire to prevent opening.
3. Fill the baskets with a further depth of 12 inches of stone and tie the two connecting wires at this level.
4. Fill the basket uniformly to the top and bend the lid over by hand until it meets the front and ends of the basket module. Tightly bind the lid to the edges of the basket with lacing wire along all edges and also along internal cell diaphragm top edges with binding wire. Tightly loop the binding wire around every other mesh opening along the seams in such a manner that single and double loops are alternated.
5. Connecting wires are not required in wire enclosed riprap baskets of 18 inches or less in depth unless they are being used to build vertical structures; in this case, two connecting wires, one in each direction, at 9 inches from the base will be placed and the lid secured in the same manner as described above.
6. Connecting wires are not required in wire enclosed riprap baskets of 12 inches or less in depth.

H. Begin assembly and stone placement at the lowest layer or row of wire structures.

I. Tie each subsequent layer or row to the one below and tie adjoining structures.

J. Use wire equal to that required for selvage wire.

K. Install anchors according to manufacturer's recommendation.

END OF SECTION

SECTION 02373

RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing loose riprap, hand-placed riprap, compacted riprap, and plated riprap.

1.2 RELATED SECTIONS

A. Section 02075: Geotextiles

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

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 **Not Used**

1.5 SUBMITTALS

A. Submit data showing riprap source gradation, wear and soundness, and placement technique 10 working days before use.

B. Submit samples for Quality Assurance testing before use.

PART 2 PRODUCTS

2.1 AGGREGATE

A. Durable, angular, hard, stone that is free from seams, cracks, or other structural defects.

B. Maximum wear not greater than 40 percent when tested. Refer to AASHTO T 96.

C. Maximum 16 percent weighted loss tested according to AASHTO T 104.

D. Loose Riprap: Stones graded in size so as to produce a dense mass. The greatest dimension of fifty percent of the stone to be at least two-thirds times, but not more than one and one-half times, the specified thickness of the riprap layer. Not more than ten percent of the rock will have a dimension of less than one-tenth the indicated thickness of the riprap.

E. Hand-placed riprap: Stones of not less than 3 inches in thickness, with seventy-five percent of stones being at least one-third of a cubic foot in volume.

2.2 ACCESSORIES

A. Furnish stabilization/separation Geotextile specified in AASHTO M 288 and as approved by the Region Materials Engineer when required in the plans.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials.

B. Provide a firm foundation by excavating to a dressed uniform surface conforming to the lines and grades shown in the plans.

C. Do not over-excavate and disturb compacted foundations or undisturbed soils outside of the required lines and grades shown on the plans. Secure approval from Engineer before backfilling or installing geotextiles.

D. Install required geotextile following Section 02075 and plans.

3.2 LOOSE RIPRAP

A. Place stones to secure a rock mass, conforming to the grades and dimensions shown on the plans. Distribute and manipulate the stones in a manner that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger fragments. Place in a manner that results in unsegregated, densely placed, uniform layers of riprap of the thickness indicated on the plans.

B. Excavate at the toe of the slope and embed riprap as shown in the plans to protect against undercutting.

3.3 HAND-PLACED RIPRAP

A. Place and bed the stones, one against the other, and key together. Fill irregularities between stones with suitable size stones rammed tightly into place.

B. Provide an even, tight finished surface, true to the dimensions shown in the plans.

C. Embed riprap below the ground surface as shown on plans.

3.4 COMPACTED RIPRAP

A. Place loose riprap conforming to this Section, article 3.2, Loose Riprap where indicated on the plans.

B. Compact properly placed loose riprap in a manner that results in the development of an unsegregated dense regular tight surface of graded interlocking sizes, true to the dimensions shown in the plans and free from any irregular surface protrusions over 3 inches high.

3.5 PLATED RIPRAP

A. Place loose riprap conforming to this Section, article 3.2, Loose Riprap where indicated on the plans.

B. Compact properly placed loose riprap by repeatedly striking the riprap surface with a steel (armor) plate, approximately 5 ft by 5 ft and weighing 6,000 lbs, dropped from a height of 3 to 5 ft.

C. Compaction is complete when plating action has resulted in a reasonably uniform surface, true to the dimensions shown in the plans and free from any irregular surface protrusions over 4 inches in height.

END OF SECTION

SECTION 02374

GROUTED RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials requirements and procedures for furnishing, transporting, and installing of grouted riprap and all related materials.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregate

C. AASHTO T 99: Moisture Density Relations of Soils Using a 5.5 Lb. Rammer and a 12 inch Drop

D. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

E. AASHTO T 180: Moisture Density Relations of Soils Using a 10 lb Rammer and a 18 inch Drop

F. ASTM C 127: Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

G. ASTM C 535: Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

H. ASTM C 618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Submit in writing the following at the preconstruction conference:
   1. The source for riprap, and gradation.

2. Grout mix-design.
3. Samples for quality assurance testing before use.

1.6 QUALITY ASSURANCE

A. Grouted Riprap Sample Panel
1. Construct a 4 ft long x 4 ft wide x 1½ ft thick sample panel. Integrate the sample panel in the project quantity. Retain samples of cements, sands, aggregates, and additives used in this sample for comparison with materials used in the project. For small quantities less than 20 square feet, reduce or revise sample panel size according to the resident engineer directions.
2. Use the accepted 4 ft x 4 ft x 1½ ft sample panel as a standard to judge consistent visual appearance, acceptable workmanship, joint treatment, curing, cleaning and construction techniques to be used through out the project.
3. Remove sample panel upon completion and acceptance of riprap installation.

B. Riprap Source
1. Set up riprap source location inspection meeting with the Engineer and source material owner prior to delivering materials to project site.
2. Identify stock piling procedure.
3. Provide written certification verifying the quality of riprap existing at the industrial source. Certify that “reactive” stone are not found in the quarry pit. Alkali-silica and alkali-carbon reactions are the most frequent of these reactions. Perform a petrographic analysis on representative aggregate samples to determine whether reactive stones are present in the absence of a documented 10-year history of use of quarry aggregates in commercial concrete mix designs.
4. Provide historic results on reactivity of the rock or petrographic analysis of the proposed materials for rip rap.

C. Preconstruction Conference
1. Provide
   a. Proposed source sites
   b. Material test results
   c. Grout mix design
   d. Quality control plan

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and stock pile enough stone onsite for project.

B. Prevent contamination of the stone surfaces with clays or similar materials.

C. Remove any stone that does not conform to this specification.
   1. The Engineer may reject any stones not conforming to this specification.

PART 2 PRODUCTS

2.1 RIPRAP ELEMENTS

A. Stone quality
   1. Use angular stones that are sound and durable against disintegration, and that have their greatest dimensions no greater than three times their least dimensions.

B. Meet the following tests minimum requirements for stone.
   1. Maximum wear not greater than 40 percent when tested according to ASTM C 535.
   2. Minimum specific gravity of 2.64 when tested according to ASTM C 127.
   3. Weighted loss not greater than 10 percent when tested according to AASHTO T 104.

C. Stone gradation
   1. Provide stones for grouted riprap of 1½ to 2 feet thick that meet the gradation requirements detailed in Table 1.

Table 1

Gradation Requirements		
Stone Sizes		**Percent *Larger* Than Given Stone Size**
Equivalent Diameter (Feet)	Weight	For 1½ to 2 ft Grouted Riprap Thickness
2.25	½ Ton	0-5
1.75	¼ Ton	50-100
1.25	200-Lb	- - -
1.00	75-Lb	95-100

D. Use gradations that allow full grout penetration around the rocks.

2.2 GROUT

A. Provide grout that meets the following requirements.
   1. Minimum 28-day compressive strength of 3000 psi, conform to strength testing requirements of Section 03055.
   2. Minimum air content of 5 percent.
   3. Use the approved mix design desired by the contractor.
   4. Use a minimum of six sacks of type II portland cement per cubic yard of grout.
   5. Submit a grout mix design that readily flows into the open spaces between the stones with the riprap gradation used.
   6. Add 1.5 pounds of fibermesh or equivalent per cubic yard of grout.
   7. Do not use calcium chloride admixtures.

2.3 ACCESSORIES

A. Portland cement: Use portland cement conforming to Section 03055.

B. Pozzolan:
   1. Use Pozzolans conforming to Section 03055 and specification ASTM C 618. Class F, in amounts not to exceed 25 percent, based on absolute volume.
   2. Use an equivalent amount of portland cement in the grout mixture as a substitute.

C. Aggregates: Conform to the requirements of Section 03055.

D. Water: Use water that conforms to requirement of Section 03055.

E. Air-entraining admixtures: Refer to Section 03055.

F. Other admixtures: Refer to Section 03055.

G. Use products to clean rock surfaces that are known to be compatible with cementitious grouts. Use in accordance with manufacturer's instructions.

2.4 BEDDING MATERIALS

A. Conform to AASHTO M 288 for geotextile layer.

B. Provide a class of geotextile conforming to the requirements for strength detailed in Table 1 of AASHTO M 288 that is appropriate for the installation methods used.

C. Provide a geotextile conforming to the requirements for subsurface drainage detailed in Table 2 of AASHTO M 288 that is appropriate for the in-situ soils encountered.

D. Use imported free-draining bedding aggregate material consisting of sand, gravel, or crushed stone meeting the following gradation. Do not use on-site materials.

E. Provide 6 inches of granular bedding aggregate material under the grouted riprap.

F. Use Granular Bedding Gradation according to AASHTO T 27 meeting Table 2 requirements.

Table 2

Granular Bedding Gradation	
U.S. Standard Sieve Size	**Percent by Weight *Passing* Square Mesh Sieves**
1½ - inch	100
¾ - inch	20-90
⅜ - inch	- - -
No. 4	0-20
No. 100	- - -
No. 200	0-3

PART 3 EXECUTION

3.1 PREPARATION

A. Install surface and ground water control measures as needed to perform work in dry conditions. Water control measures include, but are not limited to diversions, culverts, sumps with pumps or other means necessary to maintain the level of groundwater below subgrade elevation and to divert surface water away from the work area.

B. Remove all topsoil, loose excavated materials, trees, timber debris, soft yielding material and concrete debris, and other objectionable materials from beneath the areas where the grouted riprap is to be placed and as shown on the plans. Do not block natural drainage layers or horizons within the channel bottom.

C. Place any approved on-site material and compact as specified to the designated subgrade elevation.
   1. Do not backfill depression with shattered shale materials.
   2. Spread fill materials uniformly minimizing segregation.

3. Compact subgrade to 95 percent maximum density, AASHTO T 99, or to a 70 percent relative maximum density, AASHTO T 180.
4. Smooth graded areas maintaining specified slope with no more than 3 inches change unless closer tolerances are specified.

D. Install a free draining bedding layer around the weep drains in the location indicated on the plan sheets.
   1. Provide sufficient cover to prevent crushing by riprap elements.

E. Notify the Engineer before placing riprap elements over bedding layer.

F. Do not place riprap until the Engineer has verified compaction requirements.

3.2 PLACEMENT OF BEDDING MATERIALS

A. Place geotextile loosely with no wrinkles or folds.
   1. Use care so that the geotextile is in contact with the soil.
   2. Eliminate all void spaces between the geotextile and the soil surface.

B. Overlap adjacent edges of geotextile a minimum of 18 inches or as shown on the plans.

C. Overlap the upstream geotextile over the downstream.

D. Repair or replace damaged geotextile at no expense to the owner.

E. Repair damaged geotextile by placing a geotextile patch, extending 3 feet in all directions beyond the damaged area.

F. Place free-draining bedding aggregate on the geotextile.
   1. Prevent damage to the geotextile.

G. Place drainage aggregate immediately after placing the geotextile.

H. Maintain 3 inches minimum bedding aggregate thickness.
   1. Finish the surface of the drainage aggregate free of mounds.

3.3 PLACEMENT OF RIPRAP ELEMENTS

A. Install the riprap in place of the specified depth.
   1. Distribute larger stones uniformly.
   2. Do not group stones as a substitute for larger stone.

3. Arrange individual stones as necessary by use of equipment or grapple device or hand in order to maintain the specified gradation and interlock.

B. Provide adequate access when placing stones in the grout to lower portions of the stone to prevent voids from forming.
   1. Place stones to secure a stone mass with the minimum thickness and height indicated.

C. Provide a riprap surface conforming to the lines and grades and adjacent channel surfaces as shown on the plans.
   1. Manipulate the stone if necessary to secure a regular surface of graded size and mass stability.
   2. Remove any stones projecting above the finished design grade more than 10 percent of the stone layer thickness.
   3. Make smooth transition without cutting or breaking stones.

D. Do not crush the weep drains extending into the underlying granular drain material.
   1. Select drain pipe materials that are compatible with the chosen method of riprap placement.

E. Place all stones in a dry condition beginning at the toe of the slope or other lowest point.
   1. Provide weep holes of 3 inch diameter pipe penetrating the bedding with an average spacing not to exceed 10 feet on center at the toes of slopes.

F. Form all outer edges and the top of grouted riprap where construction terminates so that the surface of the work is embedded and even with adjacent slope or ground.

3.4 RIPRAP GROUTING

A. Do not place grout mix when the daily minimum temperature is less than 40 degrees F.
   1. Maintain at minimum temperature of 50 degrees F and not more than 90 degrees F during the placement and the curing periods.

B. Do not place on frozen surfaces.
   1. Cover the grouted stone and heat within a range of 50 and 90 degrees F for a minimum of 24 hours prior to placing grouting materials when temperature is below 40 degrees F and dropping.

C. Thoroughly wet riprap, bedrock, and foundation surfaces.
   1. Allow excess water to drain.

2. Achieve a dry saturated surface condition.

D. Use low pressure to inject grout into the voids between stones by pumping through a maximum 2-inch diameter hose.
   1. Stop the flow at any time.

E. Deposit grout to fill all voids as stones are placed.
   1. Secure maximum compaction and density of the grout.

F. Place the grout from bottom to top and use sufficient grout to fill all voids between the stones.
   1. Fill all voids with grout from the subgrade level through the stone layer.
   2. Grout must penetrate to subgrade.
   3. Use a “pencil” vibrator fill all voids between and under stones.

G. Leave grout joints recessed below the surface of the adjacent stones.
   1. Leave the top surface of the stones fully exposed.
   2. Immediately remove all excess grout with a stiff brush augmented with a cleaning agent if needed.

H. Do not use grout to cover the surface of the stone.
   1. Construct the grouted riprap having a rustic appearance.
   2. Match the workmanship of the sample panel.

I. Do not clog the weep drainpipes or clog the filter drain materials.

J. Do not re-temper grout mix by adding water in field.

3.5 CURING AND PROTECTION

A. Keep exposed surfaces continuously moist for the seven-day curing period.

B. Maintain moisture by sprinkling, fog spraying, or by covering with continuously moistened canvas, cloth mats, straw, sand or similar material.
   1. Protect the grout during the curing process without causing damage to the grout surface by erosion or other mechanisms during water or moist covering.

END OF SECTION

SECTION 02376

EROSION CONTROL BLANKETS/CHANNEL LINERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Approved erosion control products for slopes and channels.

B. Installation requirements.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. Erosion Control Blanket: Fabric applied on slopes to prevent soil erosion and protect the seedbed.
   1. Machine-produced fabric consisting of elongated wood, coconut fibers, or straw bonded together.
   2. Hydraulically applied bonded fiber matrix.

B. Flexible Channel Liner: A machine-produced mat consisting of elongated materials that are bonded together and used to line channels.

1.5 SUBMITTALS

A. A sample of the blanket or liner, staples and other materials used, manufacturer's specifications, and recommended installation requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original wrapping showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 EROSION CONTROL BLANKETS

A. Contact Engineer for approved erosion control blankets.

2.2 FLEXIBLE CHANNEL LINERS

A. Contact Engineer for approved channel liners.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete and approve all required grading, topsoil placement, and seeding in areas to receive erosion control blanket or channel liner before placing the product.

B. Apply the blanket or liner within 24 hours after seeding or before precipitation falls.

C. Replace eroded material, rework the soil, and reseed before installing the blanket or liner if a precipitation event occurs creating soil erosion before the blanket is installed.

3.2 INSTALLATION

A. Install the erosion control blanket or channel liner strictly following manufacturer's specifications.

B. Minimize disturbance of the prepared seedbed.

C. Allow the blanket or liner to lay loosely on the soil to achieve maximum soil contact. Remove roots, branches, or other loose objects that cause the blanket or channel liner to "tent." Place roots and branches on areas already blanketed. Do not stretch the blanket during installation.

D. Install channel liner to allow runoff to flow directly to the centerline of ditch, not undermining or bypassing the lined ditch.

E. Staple the blanket or liner using manufacturer's specifications. Staple requirements vary according to the steepness and length of the slope.

F. Place additional staples in areas such as swales, base of humps, against rock outcrops, and as required to achieve maximum contact between the blanket and the soil.

END OF SECTION

SECTION 02455

DRIVEN PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, equipment, and procedures for driving steel piles.

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 252: Welded and Seamless Steel Pipe Piles

D. ASTM D 4945: High Strain Dynamic Testing of Piles

E. AASHTO/AWS Welding Specifications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Complete and submit the "Pile and Driving Equipment Data" form located at the end of this Section for each proposed hammer and pile/structure combination.
   1. Provide all data in the form necessary to perform a pile driving wave equation analysis, together with preliminary schedule for driving.
   2. The Engineer will provide within 14 calendar days of submitting the form, either:
      a. Approval to continue
      b. Notification of inadequate equipment

B. Include manufacturer's product data, specifications, and recommended installation instructions for the submitted pile hammer.

PART 2 PRODUCTS

2.1 PIPE PILE SHELLS

A. Use new pipe pile shells having wall thickness as shown on plans.

B. Meet requirements for ASTM A 252 steel for either Grade 2 normal strength or Grade 3 high strength steel or for other minimum yield stress values shown on the plans.

2.2 STEEL HP SECTION PILES

A. Follow AASHTO M 270 for Grade 36 or 50 steel, as specified in the plans.

2.3 PORTLAND CEMENT CONCRETE

A. Class A(AE) concrete following Section 03055.

2.4 REINFORCING STEEL

A. Meet AASHTO M 31, Grade 60.

B. Follow requirements in Section 03211.

2.5 PILE DRIVER

A. Verify the equipment can drive piles to the required ultimate driving resistance without damage or without requiring an excessive number of blows to achieve the required tip elevation and capacity before mobilizing pile driver to the site, in accordance with this Section, article 1.4, paragraph A.

B. Mobilize pile driver to the site only after the Engineer indicates that acceptable results of the wave equation analysis have been obtained in accordance with this Section, article 1.4, paragraph A.

C. Remove any mobilized pile driver and related equipment found to be inadequate for the project pile driving conditions, and repeat the requirements of this Section, article1.4, paragraph A until an acceptable pile driver system is obtained.
   1. Re-mobilize the accepted hammer at no cost to the Department.

D. Provide accurate test information regarding the yield stress values (heat) for each batch of piles to be used on the project.

E. Equip pile driver following Manufacturer's recommendations.

F. Leads:
   1. Used with all types of hammers.
   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 to the lowest point that the hammer must reach.
   5. Obtain approval from the Engineer before using followers.
   6. Use fixed leads if necessary to maintain required driving tolerances described in this Section, article 3.3, paragraph C.

G. Drive Cap or Drive Head: Fits the top of pile and provides full bearing. For pipe piles, drive cap to have a machined surface to fully engage the end of the pipe.

H. Hammer:
   1. With fully operable adjustable settings.
   2. Rated energy greater than or equal to the value indicated on the foundation plans.
   3. Inspect hammer cushion with the Engineer present before beginning pile driving and after every 100 hours of pile driving. Replace the cushion when it loses 25 percent or more of its original thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all foundation excavation before driving piles.

B. Dewater excavation at least 1 ft below bottom of foundation at all times during pile foundation operations.

C. Notify the Engineer of any conflicts between the designated position of piles and the locations of existing piles from previous construction, existing utilities, old foundations, or other potential conflicts. The Department designates new pile locations as required.

3.2 DYNAMIC ANALYSIS OF PILE DRIVING

A. Notify the Engineer at least five working days before pile driving is to begin on the project, and at least five working days before piles are to be driven on all subsequent abutment and bent foundations.

B. The Department or a Department authorized geotechnical firm conducts at least one high-strain dynamic test in accordance with ASTM D 4945 per foundation (abutment, bent, or pier foundation). The Department performs this test using pile driving analysis (PDA) equipment on the driving of the first pile at each abutment and bent/pier foundation.

C. Cooperate with the Department in conducting PDA including, but not limited to, the following:
   1. Provide adequate space and conditions for the PDA rig and equipment.
   2. Climb the driver leads as necessary to attach, check and remove PDA gages; or provide a platform at least 4-foot square with a 4-foot high safety rail, equipped to be raised to the top of the pile located in the leads, to allow personnel to safely attach and remove gages.
   3. Begin installation of dynamic analysis gages after placing the pile in the leads. Allow approximately one hour per pile for installation of dynamic measuring equipment. 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 stress exceeds the specified limit during the test.
   5. Drive the pile until the test indicates the required driving resistance shown on the plans is achieved, unless otherwise indicated by the Department.

D. The Department evaluates the driving resistance, and establishes driving criteria, using a wave equation analysis program with signal matching.
   1. Do not drive other piles in the foundation until the Department 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. Perform a restrike PDA test on the pile after a sufficient time period (generally 24 or more hours after the initial driving of the pile) if sufficient capacity is not obtained on initial drive testing.
   1. Do not perform restrikes using a cold hammer.

F. Notify the Engineer if any of the remaining piles in the foundation do not meet the established driving criteria before moving hammer away from bent/abutment area or if driving conditions otherwise change.
   1. The Department may require testing additional piles and reestablishing driving criteria for the remaining piles within the foundation.

3.3 PILE INSTALLATION

A. Pre-drill or pre-auger if the designated pile tip elevation cannot be reached by the approved pile driver.
   1. Do not drill holes greater in diameter than the diameter or other maximum dimension of the pile.

B. Pile Splicing:
   1. Use no more than one spliced section less than 6 ft, and splice no other section less than 30 ft for any pile.
   2. Inspect the driven pile section before splicing any pile section to determine if it has been distorted from its original shape, or otherwise damaged from pile driving operations.
      a. Remove the damaged portion where distortion or damage has occurred, before splicing the next segment.
   3. Splice new pile segments parallel with previously driven pile segments.
   4. Butt weld the entire pile cross section using full penetration welds as per AWS D.1.1 for pipe piles and AASHTO/AWS D.1.5 for HP section piles.

C. Keep driven piles within 6 inches of the designated plan location, and within 2 percent of vertical (plumb) throughout the total length of the pile (including bending). This is roughly equivalent to ¼ inch in a foot, or 0.60 inches in 30 inches.
   1. Verify that these criteria have been met, including using a calibrated pile bending probe where necessary, at the end of pile driving before proceeding with backfilling or other associated foundation work.
   2. Notify the Department to determine the appropriate resolution if either requirement is not met.
   3. Contractor bears all costs for any measures required to resolve the non-conformance including the price reduction factors shown in Table 1 in this Section, article 3.5.

D. Drive additional piles as required to replace damaged piles and piles driven out of plumb or plan location at locations designated by the Engineer.

E. Drive down piles that were raised due to driving adjacent piles.

F. Notify the Department of water collecting in open pipe piles so that they can be evaluated for possible damage.
   1. Drive additional piles as described above and abandon damaged piles as directed by the Department as necessary to resolve concerns with pile damage.

G. Cover open-ended pipe piles to prevent the collection of precipitation, other sources of water, or debris.

H. Cutting and Capping Piles:
   1. Remove all damaged material from the top of the piles.
   2. Keep sides of piles at least 9 inches away from nearest edge of pile cap.
   3. Cut off piles with clean, straight-line cuts to the designated elevation at a right angle to the pile axis.
   4. Level all irregularities before placing concrete for pile cap.

I. Fill any annular space between the pipe shell and the surrounding soil with grout or clean sand washed down to reestablish lateral support.

J. Remove all loose and displaced materials from around the completed piles leaving clean, solid surfaces to receive the concrete.

K. Level all irregularities before constructing pile cap.

3.4 CONCRETE FILLING CLOSED-END PIPE PILES

A. Remove water and debris from pipe piles before filling with concrete.

B. Receive approval from the Engineer before concrete placement in pipe piles.

C. Fill pipe piles with specified concrete after compliance with all tolerances and required criteria have been confirmed by the Engineer.

D. Avoid segregation of the concrete ingredients.

E. Slump at the time of placement: between 4 and 6 inches.

F. Arrange chutes, pipes, etc. used as aids in placing concrete so concrete does not separate (i.e. flows freely without having to be pushed or shoveled).

G. Place concrete in pipe shell either by free fall or through a tremie, drop chute, or concrete pump.

H. Place concrete to the base without contacting either the rebar cage or the pipe wall.

I. Discharge concrete into a funnel-type downpipe centered over the hopper or bucket if a hopper or concrete bucket is used.
   1. Do not discharge concrete directly from the mixer into the hopper or bucket.

J. 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.

K. Do not vibrate concrete that has taken initial set.

L. Vibrate concrete again after inserting cage to eliminate voids around the cage if rebar cage is inserted after concrete has been placed.

M. Place the reinforcement cage into the driven pipe pile when the concrete reaches the planned bottom elevation of the reinforcement for piles larger than 16 inches in diameter.
   1. Support the reinforcement so it remains within 2 inches of the required vertical location.
   2. Support the cage from the top until the concrete reaches the top of the pile.

N. Secure rebar cage in position until concrete is set.

O. Provide lighting to the work site if concrete placement is to occur after daylight hours so all operations are plainly visible.

P. Embed the tops of piles in the concrete pile cap as shown on the plans.

3.5 PRICE REDUCTIONS FOR NON-CONFORMING WORK

A. Price Adjustment - Reduction for Deficient Strength Concrete:
   1. Consider acceptance for concrete in pipe pile shells that are below the specified strength according to this Section.
   2. The Department will:
      a. Use Contractor's unit bid price and the pay factors schedule presented in Section 03055 to calculate the price reduction for compensation.

b. Evaluate concrete with a compressive strength deviation of more than 400 psi below the specification, to determine capability of the material to maintain the integrity of the concrete-filled pipe pile.
   1) Provide acceptance for:
      a) A 50 percent pay factor or
      b) Direct another pile driven at a suitable location adjacent to the deficient pile.

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. Accept piles according to this Section, article 3.5.
      b. Reject any pile driven outside the upper deviation limits shown in Table 1 below.
         1) No payment made for the rejected pile.
      c. 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, in. (deviation from 6 in.)
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 most critical of the two criteria (i.e. having the lowest pay factor) for any one pile.

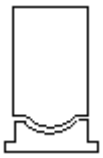
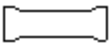
END OF SECTION

The recommended "Pile and Driving Equipment Data" form follows.

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	Material #1 Material #2 Name: _____ _____ Area: (in^2) _____ _____ No. of Plates: _____ _____ Thickness: (in) _____ _____ Mod. of Elasticity - E: _____ _____ (psi) Coeff. of Restitution - e: _____ _____
		**Drive Cap**	Helmet Weight: _____(lbs) Bonnet Anvil Block Drive Head
		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		**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. Material, equipment, and procedures for constructing drilled shafts.

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. Submit to Engineer procedure to place concrete under water.

1.6 QUALITY ASSURANCE

A. If shaft installation is unsatisfactory or the shaft cannot be completed within the required tolerances:
   1. Immediately remove the reinforcing steel cage and the concrete.
   2. Replace the reinforcing cage and place concrete in a satisfactory manner.
   3. Submit proposed remedial action for approval if the reinforcing steel and concrete cannot be removed.
   4. Furnish materials and work necessary to correct out-of-tolerance drilled shaft construction at no cost to the Department.

1.7 ACCEPTANCE

A. Drilled shafts may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.
   2. The Department applies the pay factor to the measurement of the total length of any shaft containing concrete with strength tests falling below that specified.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

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

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) per Section 03055.
   4. Keep slump between 4 inches and 8 inches when tested at the truck.

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 holes:
   1. Drill straight, vertical holes to the tip elevations shown on the plans or as determined by Engineer.
   2. Remove all loose material from the bottom of the drilled holes 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 completion of placement of 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 completion of placement of concrete for the completed shaft.

6. No concrete placement time restrictions for shafts five diameters center-to-center or greater apart.

B. Casing:
   1. Furnish and place casing when required to prevent the drilled hole from caving and any time groundwater is encountered. Remove casing as the concrete is placed.
   2. Keep the bottom of the casing between 2 ft and 5 ft below the top of the concrete surface when withdrawing.
   3. Prevent concrete separation when withdrawing the casing.

3.2 CONSTRUCTION TOLERANCES

A. Install the drilled shaft within 3 inches of the plan position in the horizontal plane at the plan elevation of the top of the shaft.

B. Install the drilled shaft such that 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 such that the top of the reinforcing steel cage is no more than 2 inches above or below the plan elevation.

3.3 PLACE REBAR CAGES

A. Rigidly brace the reinforcing cage with additional reinforcing steel as needed to retain its configuration during handling and construction. Loose bars will not be permitted. Pick cage in several locations as necessary to maintain cage shape and alignment during placement.

3.4 PLACE CONCRETE

A. Fill drilled holes within 24 hours after drilling.

B. Prevent concrete from striking the steel-reinforcing cage during free-fall. Do not allow the free-fall of concrete to exceed 5 ft without the use of a tremie or a flexible metal spout.

C. Do not vibrate concrete during initial placement. Remove all muck laitance and degraded concrete from the shaft.

D. Vibrate the concrete during placement for at least the top 10 ft of the shaft.

3.5 PLACE CONCRETE UNDER WATER

A. Submit procedure to Engineer and secure Engineer's written approval to place concrete under water.

B. Use concrete pumping equipment capable of pumping at least 50 yd^3/hr against a minimum 20 ft head of concrete measured from the discharge end of the pump hose extension (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 must be greater than or equal to the depth of the shaft.
   2. Inside diameter must be greater than or equal to the concrete pump discharge hose but not more than ½ of 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 portland 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 determined immediately.
   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 pipe in the hole. Do not begin raising the 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 all unsuitable concrete is removed. Provide a positive hold down if the pipe floats to ensure that the minimum 5 ft penetration is maintained.

3.6 FIELD QUALITY CONTROL

A. If plugging of the pipe, equipment breakdown, or loss of the seal at the end of the pipe occurs:
   1. Pull the pipe, reset it 2 ft below the top of the concrete, and purge it.
   2. Lower the 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

PIPE, PIPE-ARCH, STRUCTURAL PLATE PIPE, AND STRUCTURAL PIPE ARCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing pipe.

B. Class, type, size, and thickness designations.

C. Asphalt coating for pipe.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02317: Structural Excavation

C. Section 03055: Portland Cement Concrete

D. Section 03310: Structural Concrete

1.3 REFERENCES

A. AASHTO M 36: Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains

B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

C. AASHTO M 86: Concrete Sewer, Storm Drain, and Culvert Pipe

D. AASHTO M 167: Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches

E. AASHTO M 170: Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

F. AASHTO M 196: Corrugated Aluminum Pipe for Sewers and Drains

G. AASHTO M 197: Aluminum Alloy Sheet for Corrugated Aluminum Pipe

H. AASHTO M 198: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

I. AASHTO M 207: Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

J. AASHTO M 219: Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches

K. AASHTO M 243: Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe Arches, and Arches

L. AASHTO M 245: Corrugated Steel Pipe, Polymer Precoated, for Sewers and Drains

M. AASHTO M 246: Steel Sheet, Metallic-Coated and Polymer Precoated for Corrugated Steel Pipe

N. AASHTO M 274: Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe

O. AASHTO M 294: Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

P. AASHTO M 304: Polyvinyl Chloride (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

Q. AASHTO National Transportation Product Evaluation Program

R. AASHTO Standard Specifications for Highway Bridges

S. ASTM A 849: Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

T. ASTM C 828: Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines

U. ASTM C 924: Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

V. ASTM C 969: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Sewer Lines

W. ASTM C 1103: Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

X. ASTM D 1784: Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

Y. ASTM D 3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

Z. ASTM D 3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

AA. ASTM F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe

BB. ASTM F 1417: Standard Test Method for Testing Installation Acceptance of Plastic Gravity Flow Sewer Lines Using Low Pressure Air

CC. Utah Occupation Safety and Health Regulations

1.4 DEFINITIONS

A. Pipe and Pipe Arch are identified according to diameter or by span and rise, the following definitions, and according to corrosion class.

1. Cover - The vertical extent of soil above the crown of the pipe or culvert. Refer to DG Series Standard Drawings.
2. Cross Culvert - A transverse drain, covered with embankment that allows surface runoff to pass under the embankment.
3. End Section - A structure commonly made of steel or concrete that is attached to one or both ends of a culvert or a pipe to retain the embankment, improve appearance, provide anchorage, improve discharge and limit scour at the opening.
4. Headwall - A structure, commonly made of concrete, placed at the end of culvert inlet or outlet or storm drain outlet, to anchor the pipe, to retain the highway embankment near the pipe end, and to protect the pipe ends from bank erosion and channel bed scour.
5. Invert - The floor, bottom, or lowest part of the internal cross section of a culvert, conduit or storm drain.
6. Irrigation Pipe - A pipe designed to carry seasonal irrigation water by gravity flow.
7. Paved Invert - Lining of concrete, bituminous or other materials, placed in the invert to protect the invert from abrasion or to improve the culvert hydraulics.
8. Rise - The vertical height dimension of a box, pipe arch, and arch structure.
9. Skew - The angle between a line perpendicular to the roadway centerline and the longitudinal direction of the culvert barrel.
10. Soffit - The inside top or roof of a culvert, conduit, or storm-drain pipe.

11. Span - The horizontal dimension of a box culvert, pipe arch, or arch structure.
12. Storm Drain - A closed conduit or waterway that collects and conveys storm runoff that has drainage structures at the ends of individual pipe runs such as catch basins, drop inlets, man-holes, endwalls, and other similar features by gravity flow.

B. Corrosion Classification:
1. Class A: Pipe used in mostly non-reactive soils that requires no special materials, treatments, or coatings.
2. Class B: Pipe used in moderately reactive and corrosive soils.
3. Class C: Pipe used in soils that are highly reactive and corrosive.
4. Class D: Untreated structural plate pipe used in mostly non-reactive and non-corrosive soils.
5. Class E: Structural plate pipe used in highly reactive and corrosive soils.

1.5 SUBMITTALS

A. Provide a manufacturer's Certificate of Compliance showing that furnished pipes meet or exceed the requirements in this Section, Article 2.4 paragraph A.1.

B. Provide certification that the company manufacturing HDPE pipe is enrolled in the National Transportation Product Evaluation Program (NTPEP) and that the particular pipe size they are furnishing has been tested and meets AASHTO minimum requirements for HDPE pipe.

C. Furnish a Certification of Compliance from the manufacturer certifying coating thickness.

1.6 ACCEPTANCE CRITERIA

A. General
1. Pipes are accepted according to the criteria outlined in this section. Perform the acceptance testing, or use the services of a UDOT approved third party testing company.
2. Pipes are accepted after verification that the following elements meet the specification's requirements:
   a. Horizontal and vertical alignment deviations
   b. Barrel distortion
   c. Damage to the pipe
   d. Joints
   e. Coating integrity

B. Requirements

1. Horizontal and vertical alignment deviations
2. Remove and reinstall all pipes that exceed the alignment tolerances shown in Table 1.

Table 1

Tolerances		
Installation Alignment Tolerances		
Design Grade	**Horizontal Deviation**	**Vertical Deviation ***
		inches/100 feet
> 1%	Horizontal joint deflections not to exceed industry standards	1½
≤ 1%		1
< 0.5%		± 0.5

* For cross culverts increase tolerance by 50 percent.

3. Joints
   a. Cross Culverts - Provide pipes with joints that pass a 3 psi pressure test in the laboratory according to this Section, Article 2.4 paragraph A.
   b. Storm Drains – Provide pipes with joints that pass a 5-psi pressure test or any other pressure requirements specified in the plans. Test pipes according to this Section, Article 2.4 paragraph A.
   c. Irrigation Pipe – Provide pipes with joints that pass laboratory tests for 5 psi or any other pressure requirements specified in the plans.
   d. Pipe Arches and Structural Plate Pipes – Install according to manufacturer's recommendations and are not pressure rated.
4. Allowable distortions – Provide installed pipes that do not have ovaling or distortions greater then 5 percent of the nominal pipe diameter. Measure distortions using a mandrel or directly. Use measured diameter to calculate the 5 percent tolerance limit for nominal pipe diameter larger than 48 inches.

C. Inspection and testing

1. The inspection and testing is divided into two categories:
   a. Cross Culverts
   b. Storm drains and irrigation pipes.
2. Table 2 shows the inspection and testing required according to pipe category. Inspect or test with the Engineer or his representative present the cross culverts, storm drains, and irrigation pipes installation prior to placing the roadway pavement.

Table 2

Pipe Testing Requirements According to Pipe Function					
Pipe Category and Size	**Visual**		**Physical**		**Leakage**
	Sight	**Video Recording**	**Manual Measure**	**Mandrel See Article 1.6.C6**	**Air or Water Test**
Cross Culverts ≤ 48-inch dia.		X*	X*	When visual shows non compliance with criteria in this section	
Cross Culverts > 48-inch dia.	X		X		
Storm Drains/Irrigation Pipes ≤ 48-inch dia.		X*	X*	When visual shows non compliance with criteria in this section	When visual test shows non compliance with criteria in this section
Storm Drains/Irrigation Pipe > 48-inch dia.	X		X		When visual test shows non compliance with criteria in this section

* Both methods are acceptable for pipes with diameters larger than 30-inches

3. Inspect 25 percent of all the cross culvert, storm drain installations, and irrigation pipe units, selected by the Engineer. Round to the highest whole unit. Test any pipes with apparent defects as directed by the engineer. The Department will pay the cost of any requested additional tests that show the pipe tested being in compliance with the criteria in this section.
4. Sample Unit
   a. Cross culverts, the entire length of the cross culvert.
   b. Closed conduits, such as storm-drains and irrigation pipes, the entire length of pipe between manholes or other junction structures.
5. Visual Inspection
   a. Visually inspect pipes as required in Table 2 with an Engineer's representative. Follow OSHA requirements for inspecting confined entry spaces.

b. Provide and use a mobile color video camera with an appropriate light to show the interior of the pipe, able to move inside the pipe barrel and controlled remotely by the inspector to inspect installed pipes as required in Table 2.

c. Provide a remote monitor and a recording apparatus for the camera to view and record the condition of the installed pipes.

d. Provide a digital copy of the pipe inspection video recording to the Engineer.

6. Mandrel Test - The Engineer can require a mandrel test according to the following criteria when visual inspection documents concern of pipe deformation.

   a. Test pipe by hand pulling a fabricated mandrel through the sample unit.

   b. Provide and use mandrels to verify that the installed pipes meet the specification requirements in Table 2 of this specification.

   c. Provide the following:

      1) A mandrel acceptable to the Engineer.

      2) A mandrel with an effective diameter equal to 95 percent of the nominal inside diameter.

      3) A proving-ring to verify mandrel size.

      4) A mandrel with a minimum of nine equally spaced runners (40 degree angles).

7. Manual Measurement

   a. Measure manually any pipe distortions or deflections as indicated in Table 2 and verify in the presence of the Engineer or his representative that the installed pipes sample meet the criteria in Table 2.

8. Joint Test for Storm Drains and Irrigation Pipes only - In addition to the inspection requirements in this Section, Article 1.6 paragraph C, test units with diameters equal to or less than 42 inches when visual inspection indicates noncompliance with the criteria in this section. Test all pipes that have joints showing visible gaps, defects, or any other problem according to one of the following testing methods:

   a. Air Test

      1) Test individual joints according to ASTM C 1103.

      2) Concrete Pipe – Test according ASTM C 924.

      3) Plastic Pipe – Test according to ASTM C 828, C 924, or F 1417 and manufacturer's recommendations.

   b. Exfiltration Test

      1) Test all pipe material types according to AASHTO M 86 and ASTM C 969.

      2) Maintain head for one hour.

      3) Do not exceed leakage values in Table 3.

4) Locate source or sources of leakage and repair damaged storm drain or irrigation system that does not pass the test.

Table 3

Leakage Test Allowances	
Nominal Pipe Diameter (Inches)	Maximum Leakage Allowed (Gal/hr/100 feet)
18	4.5
24	6
30	7.5
36	9
42	10.5
48	12

D. Quality Assurance

1. Repair or replace damaged or improperly installed pipes in a sample unit at the direction of the Engineer.
2. Repair according to manufacturer's recommendations pipes that fail the Joint Test in this Section, Article 1.6 paragraph C at no cost to the Department. Retest the repaired pipes. Remove and replace pipes if they fail retest.
3. Provide engineering analysis certifying the structural and hydraulic integrity of the pipe to the Resident Engineer and Central Hydraulics, signed and sealed by a professional engineer licensed in the State of Utah, for all pipes that fail the mandrel test and that do not exceed 10 percent deflections, for the pipe acceptance.
4. Apply the pay reduction schedule in Table 4 for sample units left in place that have pipes that do not meet mandrel test requirements if an engineering analysis is not performed:

Table 4

Pipe Deflection Payment Reductions	
Amount of Deflection (%)	Payment
0.0 to 5	100% of the Unit Bid Price
5.1 to 9.9	75% of the Unit Bid Price
10 or greater	Remove and Replace

5. Remove and replace all pipes that exceed 10 percent deflections.

PART 2 PRODUCTS

2.1 PIPE TYPES

A. Pipe, Pipe Arch, Structural Plate Pipe and Structural Plate Pipe Arch Types: Refer to Table 5.

Table 5

AASHTO Reference Specifications for Pipe					
Pipe Type	**Pipe Class**				
	A	**B**	**C**	**D**	**E**
Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class D.					
Corrugated Pipe and Pipe Arch:					
Corrugated steel pipe. Corrugated steel pipe arch. **(1)**	M 36	M 36 Polymeric Coating 0 µm (inside)/250 µm (outside) M 245 & M 246 ASTM A 849 or Aluminized Type II Steel M 274 (2)	M 36 Polymeric Coating 250 µm (inside)/250 m (outside) M 245 & M 246 ASTM A 849	N/A	N/A
Corrugated aluminum pipe. Corrugated aluminum pipe arch. **(1)**	M 196 M 197	M 196 M 197	M 196 M 197	N/A	N/A
Corrugated polyethylene (HDPE) pipe	M 294 ASTM D 3350	M 294 ASTM D 3350	M 294 ASTM D 3350	N/A	N/A
Smooth-Lined Pipe and Pipe Arch:					
Concrete lined corrugated steel pipe (Use Type V cement. Refer to Section 03055)	M 36	M 36 Polymeric Coating 250 µm (inside)/250 µm (outside) M 245 & M 246 ASTM A 849	M 36 Polymeric Coating 250 µm (inside)/250 µm (outside) M 245 & M 246 ASTM A 849	N/A	N/A
Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter	M 294 ASTM D3350	M 294 ASTM D3350	M 294 ASTM D3350	N/A	N/A
Smooth lined Polyvinyl chloride (PVC) pipe	M 304 Cell Class # 12454C ASTM D 1784	M 304 Cell Class # 12454C ASTM D 1784	M 304 Cell Class # 12454C ASTM D 1784	N/A	N/A

AASHTO Reference Specifications for Pipe					
Pipe Type	**Pipe Class**				
	A	**B**	**C**	**D**	**E**
Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class D.					
Spiral rib steel pipe Spiral rib steel pipe arch	M 36	M 36 Polymeric Coating 0µm (inside)/250 µm (outside) M 245 and M 246, ASTM A 849 or Aluminized Type II Steel M 274 (2)	M 36 Polymeric Coating 250 µm (inside)/250 µm (outside) M 245 and M 246 ASTM A 849	N/A	N/A
Spiral rib aluminum pipe and pipe arch	M 196 and M 197	M 196 and M 197	M 196 and M 197	N/A	N/A
Reinforced concrete pipe	M 170 Type II Cement	M 170 Type II Cement	M 170 Type V Cement required	N/A	N/A
Non-reinforced concrete pipe	M 86 Type II Cement	M 86 Type II Cement	M 86 Type V Cement required	N/A	N/A
Elliptical reinforced concrete pipe	M 207 Type II Cement	M 207 Type II Cement	M 207 Type V Cement required	N/A	N/A
Structural Plate Pipe and Pipe Arch:					
Structural steel plate pipe and pipe arch	N/A	N/A	N/A	M 167	M 167 M 243
Aluminum alloy structural plate pipe and pipe arch	N/A	N/A	N/A	M 219	M 219
Footnotes: (1) Minimum corner radii conforming to the details shown on the standard drawings. (2) Acceptable Soil Conditions, Class B, Aluminized Type II Steel are: 1.6mm minimum thickness of metal acceptable where pH is greater than 7 and less than 8.5, and soil resistivity is greater than 1500 ohm-centimeters.					

2.2 RELATED PRODUCTS

A. Asphalt Coating: Furnish Material Class M-Mastic, either asphalt or tar base, cold applied. Refer to AASHTO M 243 and ASTM A 849.

2.3 PIPE SELECTION

A. Use the same type and strength or thickness for the entire run of pipe.

B. Use the maximum height of cover to determine the strength or thickness. Refer to the DG Series Standard Drawings.

C. Do not use aluminum pipe when a paved invert is required unless protective measures are taken. Follow this Section, Article 3.7 paragraph C.

D. Corrugated and smooth-lined high density polyethylene pipes: Use only HDPE Plastic Pipe up to 60-inch diameter that is certified by AASHTO National Transportation Product Evaluation Program (NTPEP)to meet AASHTO M 294 requirements and. Provide a copy of NTPEP certification to the Engineer.

E. Corrugated and smooth-lined PVC pipes: Use up to 36 inch diameter.

F. Furnish Material Pipe Coating Class M-Mastic, either asphalt or tar base, cold applied. Refer to ASTM A 849.

G. Precast, non-reinforced concrete pipe: Use only 18 inch to 36 inch diameter.

H. Do not allow pipes of different types of metal to contact each other. Use matching materials to make direct extensions of existing pipes.

I. Do not use pipe containing longitudinal lap seams if watertight pipe or watertight joints are called for.

J. Do not use thermoplastic pipe manufactured without UV inhibitors approved by the Materials Engineer in applications subject to direct sunlight.

2.4 JOINTS OR COUPLING BANDS FOR PIPES

A. General:
   1. Furnish pipes with joints that can sustain 3 psi minimum pressure for all cross culverts or 5 psi minimum pressure for all storm-drains and irrigation pipes, tested according to the proper AASHTO and ASTM test requirements by an independent lab or witnessed by a UDOT representative, for each pipe type.
   2. Comply with manufacturer's recommendations for connecting pipes and for connecting pipes to concrete headwalls, catch basins, and similar structures.

B. Concrete Pipes:
   1. Meet AASHTO M 198.

C. Metal Pipe:
   1. Conform to AASHTO Standard Specifications for Highway Bridges and AASHTO M 36 or AASHTO M 245 with the following modifications:
      a. Use connecting bands of the same class as the pipe. Maintain a minimum thickness of 0.064 inch for the connecting bands.
      b. Use bands with projections (dimple bands) only in extension of existing pipes where annular corrugations do not exist.
      c. Re-role ends of helically corrugated pipe to form at least two full annular corrugations each before being joined.
      d. Use flat bands only when approved in writing by the Engineer.
      e. Follow DG Series Standard Drawings.

D. Test joints in the lab according to ASTM D 3212.

E. Joints for PVC Pipes: Show no leakage when tested according to ASTM D 3212. Meet ASTM F 477 for gaskets.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavating, Trenching, Bedding and Backfill:
   1. Refer to Section 02317.
   2. Refer to DG Series Standard Drawings.

3.2 INSTALLATION

A. Follow manufacturer installation requirements for installing all types of pipe.

B. Install pipe to conform to AASHTO Standard Specifications for Highway Bridges.

3.3 SMOOTH LINING FOR CORRUGATED STEEL PIPE AND PIPE ARCH

A. Clean all surfaces to be lined including removal of all oil and grease from the metal. Allow the surface to dry before proceeding.

B. Concrete Lining: Refer to ASTM A 849, Subsections 5 and 9.

C. Asphalt Lining: No asphalt coating.

3.4 PIPE AND PIPE ARCH

A. Follow AASHTO M 243.

B. Use materials described in Table 5.

C. Remove moisture, dirt, oil, un-bonded or incompatible paint, grease residual oil, alkalis, or other foreign matter from the surface to be coated.

D. Spray or brush-coat all aluminum pipes contacting concrete with an asphalt mastic or tar base material to a minimum thickness of 0.05 inch.

3.5 STRUCTURAL PLATE PIPE AND PLATE PIPE ARCH

A. Use materials described in Table 5.

B. Repair or replace all damaged plates or coatings before installation.

C. Installation: Follow DG Series Standard Drawings. Embankment: Refer to Section 02056.

D. Assembly:
   1. Give the Engineer a copy of the detail plan showing the position of each plate and the assembly order.
   2. Follow the manufacturer's instructions.
   3. Mark clearly each modified plate, designating its position in the finished structure.
   4. Place outside circumferential pipe-laps facing upstream.
   5. Attain approved seam fit-up. Place and torque all bolts according to manufacturer's recommendation.
   6. Form structural plates so that the finished pipe is elliptical with the vertical diameter of round pipe approximately 5 percent greater than the nominal diameter.

E. No Asphalt Coating allowed.

3.6 INVERT PROTECTION

A. Paved Invert:
   1. Use corrugated steel pipe or pipe arch and structural steel plate pipe or plate pipe arch.
   2. Complete backfill and embankment over the pipe before placing paved invert material.
   3. Use 10 gage wire fabric with wire spaced at 6 inch centers. Refer to AASHTO M 55.

4. Arc-weld the wire mesh reinforcement to the corrugation at not more than 2 ft centers.
5. Place concrete at least 2 inches above the crest of the corrugations, at least ¼ of the circumference of round pipe, or the span width of arch pipe. Refer to Section 03055.
6. Finish the concrete to a floated surface finish. Refer to Section 03310.
7. Coat the joint between the pipe and concrete with liquid asphalt at a rate 0.9 gal/yd^2 of residual asphalt after curing. Coat 6 inches above and below the joints.

3.7 QUALITY CONTROL

A. Provide adequate cover or protection for all pipe during project construction. Replace all damaged pipe before acceptance by the Department.

B. The following are some causes for rejection:
   1. Irregular or distorted shape (not as provided or designed)
   2. Dents or bends
   3. Damaged, broken, delaminated, or scaled coating
   4. Loose bolts or nuts
   5. Uneven laps
   6. Improper fitting joints
   7. Any damage which compromises the functionality and design life of the pipe.

C. Coatings:
   1. Department will take a representative sample from each lot furnished to conduct verification testing.

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

CULVERT END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing culvert end sections.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culverts

1.3 REFERENCES

A. AASHTO M 294: Corrugated Polyethylene Pipe, 12 to 36 inch Diameter

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 END SECTION

A. Pipe Class Definitions: Refer to Section 02610.

B. Coat metal end section identically to pipe material.

PART 3 EXECUTION

3.1 INSTALLATION

A. Use end section made of the same materials as the pipe or pipe arch to which they are connected.
   1. Exception: Use metal end section with HDPE with concrete pipe according to AASHTO M294.

B. Place end section according to construction methods specified for the type and class of pipe to which they connect. Refer to DG Series Standard Drawings and Section 02610.

END OF SECTION

SECTION 02614

SALVAGE AND RE-LAY PIPE CULVERT AND END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Salvage and relay existing pipe and culvert end section.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culverts

B. Section 02613: Culvert End Section

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 REMOVE, RE-LAY, OR SALVAGE PIPE

A. Remove pipe from existing location.

B. Replace pipe damaged during operations at no additional cost to the Department.

C. Clean pipe.

D. Relay according to Section 02610.

E. Salvage as directed.

3.2 RE-LAY CULVERT END SECTION

A. Relay the culvert end sections. Refer to Section 02613.

B. Replace culvert end sections damaged by operations at no additional cost to the Department.

END OF SECTION

SECTION 02622

UNDERDRAIN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing pipe underdrains.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02075: Geotextile

C. Section 02610: Pipe Culverts

1.3 REFERENCES

A. AASHTO M 252: Corrugated Polyethylene Drainage Pipe

B. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12 in.) drop

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 PIPE

A. Corrugated Polyethylene Drainage Pipe: ASHTO M 252.

B. Corrugated Steel Pipe and Pipe Arch: Refer to Section 02610.

C. Concrete Pipe: Refer to Section 02610.

2.2 DRAINAGE GEOTEXTILES

A. Refer to Section 02075.

2.3 UNDERDRAIN GRANULAR BACKFILL

A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PLACEMENT

A. Excavate a trench to a depth of 3 inches below the underdrain pipe flow-line and to a width of the outside diameter of the pipe plus 2 ft.

B. Place drainage geotextiles to plan requirements if required. Refer to Section 02075.

C. Place underdrain granular backfill in the trench, compacting the bottom 3 inches. Refer to Section 02056.

D. Place pipe with slots or perforations down, or as specified in the plans.

E. Lay an open joint concrete underdrain pipe with the bell or groove end up stream and the spigot end fully entered into the bell.

F. Compact backfill material in 6 inch layers to 96 percent of maximum laboratory density. Follow AASHTO T 99, Method C.

END OF SECTION

SECTION 02624

APPROACH SLAB CATCH BASIN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct a drainage catch basin in the approach slab of an existing structure.

1.2 RELATED SECTIONS

A. Section 02610: Pipe Culvert

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 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 MATERIALS

A. Use portland cement concrete: Class AA(AE). Refer to Section 03055.

B. Use coated reinforcing steel: Refer to Section 03211.

C. Structural Steel:
   1. AASHTO M 270, Grade 36.
   2. Galvanize after fabrication, AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

A. Concrete Removal:
   1. Make saw cuts 1 inch deep to define the work areas.
   2. Remove concrete using 90 pound class hand-operated jackhammers or smaller.

B. 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. Tie the new facility into the existing approach slab. Expose a minimum of 10 inches of reinforcing steel in both the bottom and upper mats of approach slab steel on at least three sides of the catch basin.

C. Excavation:
   1. Excavate sufficient material to construct the catch basin to the required size and depth.

3.2 CONSTRUCTION

A. Construct catch basin according to plan dimensions and details.
   1. Do not use Precast Concrete Catch Basin.

B. Adjust catch basin location for better drainage performance where necessary as directed by the Engineer.

C. Provide for proper outlet connection to the pipe in the side of the box. Refer to Section 02610.

END OF SECTION

SECTION 02625

APPROACH SLAB DRAIN FRAME MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide a frame riser to raise the existing 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: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel plates. AASHTO M 270, Grade 250.

B. Galvanize the frame riser after fabrication as specified. AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify plan dimension for the existing grate system before fabrication of the new frame riser.

3.2 INSTALLATION

A. Construct the frame riser according to the plan design.

B. Place a new frame riser before placing asphalt surfacing. Hand compact the asphalt 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 frames.

3.3 CLEANING

A. Clean any existing or construction debris and trash from the drain basin and grate ribs.

END OF SECTION

SECTION 02626

DECK DRAIN MODIFICATION OR CLOSURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Modify or close existing drains, and install new drains at specified locations.

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: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Galvanize the frame riser after fabrication as specified. AASHTO M 270, Grade 36. AASHTO M 111.

B. Structural steel plates: AASHTO M270, Grade 36.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify plan dimension for the existing grate system before fabrication of the new frame riser.

3.2 INSTALLATION

A. Deck Drain Modification:
   1. Construct the frame riser according to the plan design.
   2. Close the deck drains as shown in the plans under the Deck Drain Closure Detail prior to placing new asphalt surfacing.
   3. Place a new frame riser before placing Hot Mix Asphalt. Hand compact the asphalt in the areas surrounding the frame of the drain.
   4. Position the grate properly to receive the water flow. Line up square frame grate ribs with water flow.
   5. Properly secure the extended pipes to the satisfaction of the Engineer.

B. Deck Drain Closure: Close the deck drains as shown in the plans under the Deck Drain Closure Detail prior to placing new asphalt surfacing.

3.3 CLEANING

A. Clean any asphalt concrete from between the grate ribs, when necessary.

B. Clean any existing or construction debris and trash from the drain basin.

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 (Special Provision)

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: Standard Specification for 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: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

K. ASTM C 858: Standard Specification for Underground Precast Concrete Utility Structures

L. ASTM C 891: Installation of Underground Precast Concrete Utility Structures

M. ASTM C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

N. ASTM C 1244: Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

O. UDOT Quality Management Plans

1.4 DEFINITIONS

A. This specification is applicable for the following defined products:
   1. 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.
   2. 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.
   3. 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. Submit concrete mix design for approval in accordance with Section 03055 or 03056 (Special Provision).

B. Precast structures:
   1. Provide verification the structures are furnished by a Department pre-qualified precast supplier.
   2. Submit a Certificate of Compliance from UDOT Central Materials upon delivery to the project.

1.6 ACCEPTANCE

A. Construct cast-in-place or install precast drainage structures meeting the requirements of this section and all other applicable requirements.

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 having 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.
   7. Submit repair procedure to the Engineer for approval prior to performing any repairs.

C. Precast structures:
   1. Furnish precast drainage structures in conformance with the CB Series Standard Drawings.
      a. Pre-qualify the supplier in accordance with the UDOT Quality Management Plan: Precast/Prestressed Concrete Structures.
      b. Furnish precast structures that are plumb and square within ⅛ 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. When directed by the Engineer, test in accordance with this Section, article 3.3.

PART 2 PRODUCTS

2.1 CONCRETE

A. Wet cast: Class AA-AE, see Section 03055.

B. Dry cast: Submit mix design for approval.
   1. Minimum cement content: 470 lb/yd^3
   2. Maximum water/cementitious ratio: 0.40

C. Self-Consolidating Concrete: Follow Section 03056 (Special Provision).

2.2 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

B. Use coated reinforcing steel.

2.3 STRUCTURAL CONCRETE

A. Refer to section 03310.

2.4 JOINTS AND SEALERS

A. Preformed Joint Filler: 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, Subsection 8.9.3.4 for installation requirements.

2.6 NON-SHRINK GROUT

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

2.7 CURING COMPOUND

A. Refer to Section 03390.

2.8 FORMS

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

2.9 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 per ASTM C 361 as shown in the CB Series Standard Drawings.

2.10 MANHOLE/FRAME GASKET

A. Place ¾ inch diameter minimum extruded rope Type B flexible plastic gaskets between the manhole frame and the concrete risers that meet AASHTO M 198 requirements.

2.11 JOINTING MASTIC

A. Furnish a water-resistant elastic jointing mastic of plastic bituminous materials and inert fillers that when applied to a vertical metal surface and heated to 120 degrees F does not loose slump or plasticity.

B. Furnish joint mastic that can be applied evenly and adhere at temperature range of 40 to 120 degrees F or higher.

2.12 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. 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 in accordance with Section 02056.
   2. Add as needed a sand-leveling course no greater than 2 inches in depth to the backfill material. When used, excavate the area to the appropriate depth to accommodate the backfill and leveling course.

3.2 INSTALLATION

A. Manholes: Furnish precast concrete manholes according to ASTM C 478 and have self-centering watertight joints that meet ASTM C 443. Refer to CB Series Standard Drawings.

B. Grade Rings/Catch Basin Grade Sections: Furnish grade rings or catch basin grade adjustment according to ASTM C 478 with anchor bolt-holes as shown on the CB Series Standard Drawings.

C. Precast Inlets and Boxes:
   1. Furnish structures conforming 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 the plans or 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.
   3. Provide sufficient lifting points for a safe installation.
      a. Locate lifting devices to avoid interference with the reinforcing steel.
   4. Do not move precast units until after 28-day compressive strength has been attained.
      a. Protect the unit from any damage. Replace unacceptable units at no additional cost to the Department.

5. Follow 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, stones, etc. 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. 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. Finish flush with top, bottom, or both surfaces of concrete.

3.3 TESTING

A. Conduct either of the following tests 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. Furnish all necessary equipment and materials. Repair and re-test at no additional cost to the Department any structures that fail any tests. 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 prior to 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 as follows:

Diameter/Width	Time to Drop 1 inch Hg
up to 4 ft	30 seconds
up to 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 three to four inches below the casting rim or lid.
3. Let the water stand for two-hours prior to beginning the test to allow absorption into the precast structure.
4. Place additional water to bring the water level back to three to four inches below the rim or lid after the two-hour stabilization.
5. Test for at least 2 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

** For greater depths provide an engineering analysis for equivalent ex-filtration rates.

D. The Department will reimburse the Contractor for the actual cost of testing for each test required by the Engineer meeting vacuum or exfiltration requirements not to exceed $500 per test.

END OF SECTION

SECTION 02635

GRATES, SOLID COVERS, FRAMES, AND MANHOLE STEPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install grates, solid covers, frames, and manhole steps.

1.2 RELATED SECTIONS

A. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 105: Grey Iron Castings

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. ASTM A 536: Ductile Iron Castings

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: Refer to Section 05120.
   1. As specified in AASHTO M 270.
   2. Hot-dip galvanize structural steel after fabrication. AASHTO M 111.

B. Cast Grey Iron: As specified in AASHTO M 105.

C. Ductile Iron: As specified in ASTM A 536.

D. Precast Grade Ring: As specified in AASHTO M 199.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as specified by the manufacturer and the following standard specifications:

Table 1

Installation	
Item To Be Installed	**Standard Drawing**
Standard Diversion Box Hinged Lid (Solid Cover Plate) Type A Details Type I Plan and Type II Plan	DB 2E, 2F
Standard Diversion Box Hinged Lid Solid Cover Type B and C	DB 2G, 2H
Standard Diversion Box Hinged Lid Solid Cover Type C	DB 2H
Solid Cover and Frame	CB 4
Manhole Frame and Grated Cover	GF 1
Manhole Frame and Solid Cover	GF 2
Rectangular Grate and Frame (Standard Grating)	GF 3
Directional Grate and Frame (Bicycle-Safe Grating)	GF 4
Solid Cover and Frame	GF 5
Manhole Steps	GF 6

END OF SECTION

SECTION 02643

CONCRETE-LINED DITCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing concrete-lined ditch.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 03055: Portland Cement Concrete

C. Section 03152: Concrete Joint Control

D. Section 03390: Concrete Curing

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 ACCEPTANCE

A. Concrete lined ditch may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class A(AE). Refer to Section 03055.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Construct concrete-lined ditch placing contraction joints at 10 ft intervals, and expansion joints at 30 ft intervals. Refer to Section 03152.

B. Finish inside of ditch with a moist, wooden float to remove projections and honeycomb.

C. Slip-form pavers may be used.

D. Compact berm following Section 02056 when placing ditch on a raised berm.

3.2 CONCRETE CURING

A. Refer to Section 03390.

END OF SECTION

SECTION 02645

PRECAST CONCRETE BOX AND THREE-SIDED CULVERT STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material and procedures for fabricating and installing single cell precast concrete box culverts and precast conventionally reinforced concrete three-sided culvert structures.

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 07111: Dampproofing

1.3 REFERENCES

A. AASHTO M 198: Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

B. AASHTO LRFD Bridge Design Specifications

C. ASTM C 877: Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

D. ASTM C 1433: Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

E. ASTM C 1504: Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains

F. UDOT Quality Management Plan

G. UDOT Structures Design Quality Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Furnish to the Engineer:
   1. Shop drawings for all fabricated materials:
      a. Submit five copies on 11 inch by 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
      b. Detail all phases of construction including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Note proposed transportation methods.
      c. Include the project designation data and structure number in the lower right-hand corner of each sheet.
      d. Prepare shop drawings under the stamp of a Utah PE.
   2. Design calculations signed and sealed by a Professional Engineer (PE) licensed in the State of Utah for all precast concrete three-sided structures and for precast concrete box culverts requiring modified designs or special designs for sizes and loads other than those shown in Table 1 and 2 of ASTM C 1433.
      a. Not required for ASTM C 1433 standard designs.
      b. Certify that the design has been checked according to the UDOT Structures Design Quality Plan.
   3. The Engineer reserves the right to retain these drawings and calculations up to 14 calendar days without granting an increase in the number of working days for the project. This is reduced to 7 days when drawings are submitted electronically. This right applies each time the drawings are submitted.

1.6 ACCEPTANCE

A. Precast concrete box culverts and precast concrete three-sided culvert structures may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03310.

B. The Department rejects units fabricated before written approval of the fabricator's shop drawings.

PART 2 PRODUCTS

2.1 CONCRETE

A. Wet Cast Concrete: Class 3A(AE). Follow Section 03055.

B. Dry Cast Concrete:
   1. Minimum cement content: 470 lb/yd^3 of concrete
   2. Maximum water/cement ratio: 0.40
   3. Mix design: Submit for approval

2.2 REINFORCING STEEL AND WELDED WIRE

A. Coated. Refer to Section 03211.

2.3 JOINT SEALANT

A. Meet AASHTO M 198.

B. Use a flexible butyl-blend material with a minimum cross-section of 1½ square inches as a joint sealant for box culverts.

C. Maintain the joint material at 70 degrees F or greater during placement.

2.4 JOINT WRAP

A. Refer to ASTM C 877.

2.5 DAMPPROOFING

A. Refer to Section 07111.

2.6 QUALITY ASSURANCE

A. Department pre-qualifies pre-cast concrete box and three-sided culvert section manufacturers according to the UDOT Quality Management Plan: Pre-cast/Prestressed Concrete Structures.

B. Permanently mark each precast unit with date of casting and supplier identification. Stamp markings in fresh concrete.

C. Prevent cracking or damage during handling and storage of precast units.

D. Replace cracked or damaged precast units at no additional cost to the Department.

PART 3 EXECUTION

3.1 MANUFACTURE

A. Precast Concrete Box Culverts:
   1. Meet ASTM C 1433.
   2. Multiply steel reinforcement requirements shown in tables by 1.25, unless designed for HS-25 or greater loading.
   3. Provide minimum reinforcing steel spacing 4 inches around circumference and 8 inches longitudinal.
   4. Provide 1 inch minimum concrete cover to reinforcing steel for box sections covered with 2 ft of fill or greater.
   5. Provide 2 inch minimum concrete cover to all reinforcing steel for box sections covered with less than 2 ft of fill.
   6. Unless otherwise approved by the Engineer, do not locate horizontal and vertical changes in alignment at a joint between precast segments of a precast concrete box culvert.
   7. Comply with the design criteria used to develop the standard precast box culverts in ASTM C 1433, except use HS-25 live loading for modified designs or special designs for sizes and loads other than those shown in Table 1 and 2 of ASTM C 1433.

B. Precast Concrete Three-Sided Structures:
   1. Meet requirements in ASTM C 1504 with the following exceptions:
      a. Design structure in compliance with AASHTO LRFD Bridge Design Specifications, Section 12.14.
      b. Design for HL-93 live loading.
   2. Provide minimum reinforcing steel spacing of 4 inches around circumference and 8 inches longitudinal.
   3. Provide 1 inch minimum concrete cover to reinforcing steel for three-sided sections covered with 2 ft of fill or greater.
   4. Provide 2 inch minimum concrete cover to all reinforcing steel for three-sided sections covered with less than 2 ft of fill.

C. Portland Cement Concrete: Follow Section 03055.

D. Concrete Curing: Follow Section 03390.

3.2 PREPARATION

A. Excavating, Trenching, Bedding, and Backfill:
   1. Refer to Section 02317.

3.3 BEDDING AND BACKFILL

A. Over-excavate the material under the box location in compliance with Section 02317 to a minimum depth of 4 inches.
   1. Replace over-excavated material with granular backfill borrow as specified in Section 02056.
   2. Provide a minimum bedding of 4 inches of granular backfill borrow.

B. Level and compact bedding material to provide uniform support of the structure along its entire supported width and length.

C. Use a loose sand leveling course no greater than 2 inch in depth if needed in addition to the granular backfill borrow bedding.
   1. Excavate the area to the appropriate depth to accommodate the backfill and leveling course if loose sand is added.

D. Backfill structure with granular backfill borrow as specified in Section 02056.

E. Refer to project plans for excavation, bedding, and backfill requirements where a three-sided culvert structure is placed on a footing.

3.4 INSTALLATION

A. Inspect precast elements for defects before lowering into trench.

B. Repair or replace any defective, damaged or unsound precast elements.

C. Use a trench width adequate to place and compact bedding material. Minimum outside width of trench is the outside width of structure plus 2 feet.

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. Prevent dirt and material from re-entering joints.

G. Apply joint sealant furnished by culvert manufacturer to box culvert.
   1. Place the joint material on the bottom half of the groove (bell) of the box last placed.
   2. Place the balance of the joint material on the top half of the tongue (spigot) of the box to be set.

3. Place the material about 1 inch from the leading edge of the groove and tongue.

H. Disassemble joint, check position of joint sealant, repair alignment, and re-install when adjoining elements cannot be pulled together to meet minimum joint requirements.

I. Close the joints tightly.

J. Do not disturb previously completed joints during laying operation.

K. Do not lay precast elements when water is in the trench.

L. Clean top and sides of concrete surface at joints before placing joint wrap.

M. Use appropriate pulling devices to avoid misalignment and damage to box sections.

N. Place three-sided structure sections against previous sections as tightly as possible while maintaining alignment.
   1. Do not exceed joint tolerances in the stamped drawings.

O. Apply joint wrap when specified in the plans.

3.5 STEEL REINFORCEMENT

A. Follow Section 03211.

3.6 JOINTS

A. Make joint opening between box sections less than 1 inch measured face to face of adjoining concrete surfaces.
   1. Reject box sections when the installation tolerance cannot be met due to casting variations.
   2. Prevent soil from being forced into the joint as the box sections are placed.

B. Provide shear transfer devices for box culvert sections with less than 2 ft of cover.
   1. Device or method must be capable of transferring a minimum shear load of 3,000 lb/ft of joint width through top slab of adjacent units.
   2. Space closer than 2.5 ft center to center with at least two per joint when using individual devices.

C. Mechanically connect the exterior segments of three-sided precast concrete 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 feet.
   2. Galvanize all plates, shapes, and hardware.

D. Connect three-sided precast concrete structures to the footing/pedestal 2 ft from the outermost exterior edge of the structure at all four corners with a galvanized rigid mechanical connection.
   1. Locate the connection on the interior face of the segment to allow for future inspection.

3.7 LIFTING HOLES

A. Provide a maximum of four lifting holes in the top slab, each having a maximum diameter of 3 inches.

B. Locate holes to avoid interference with the reinforcing steel.

C. Plug lift holes and lift insert recesses with a 1:1 sand to cement grout. Finish flush with all concrete surfaces.

3.8 CONNECTION TO CAST-IN-PLACE CONCRETE

A. Project the reinforcing steel at least 12 inches out of the precast box section and square off the concrete face where precast box sections join cast-in-place concrete.

3.9 REPAIRS

A. Box sections may be repaired as allowed in the referenced specification only when approved in advance by the Engineer.

B. Repairs made before approval will be cause for rejection.

3.10 MINIMUM LENGTH

A. Do not use precast segments less than 5 ft in lay length.

3.11 DAMPPROOFING

A. Apply dampproofing to the full length of all concrete box culverts and three-sided structures when specified on the plans. Refer to Section 07111.

END OF SECTION

SECTION 02646

CONCRETE BOX CULVERT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for concrete box culvert.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02645: Precast Concrete Box and Three-Sided Culvert Structures

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03310: Structural Concrete

G. Section 07111: Dampproofing

1.3 REFERENCES

A. ASTM C 1433: Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 SUBSTITUTIONS

A. Precast reinforced concrete box culverts may be substituted for cast-in-place reinforced concrete box culverts shown in the plans unless specified otherwise in the Contract Documents. Meet all requirements and submittals of Section 02645 when substituting.

B. Provide an equivalent hydraulic opening to that shown in the plans.

C. A single-cell precast box of equivalent area may be substituted for a double-cell box with cell spans less than or equal to 6 ft. Any revision in the cell height from that shown on the plans is not permitted unless approved by the Engineer.

D. Two single-cell precast boxes may be substituted for a double-cell box when approved by the Engineer.

E. Make all plan changes required by substituting precast options for cast-in-place designs. This includes but is not limited to any changes to the headwalls, wingwalls and aprons, attachment detailing of the cast-in-place elements for precast sections, labor, and any redesign.

F. Notify the Department in writing at or before the preconstruction conference about which concrete box culvert type will be used at each location.

1.7 ACCEPTANCE

A. Concrete box culverts may be accepted at a reduced price when the concrete strength is below that specified.
   1. Refer to Section 03310 for price adjustment pay factor.

PART 2 PRODUCTS

2.1 CONCRETE

A. Refer to Section 03310.

2.2 REINFORCING STEEL AND WELDED WIRE

A. Coated. Refer to Section 03211.

2.3 PRECAST CONCRETE BOX CULVERT

A. Refer to Section 02645.

B. Provide cast-in-place concrete headwalls, wingwalls and aprons as shown in the plans. Detail in the fabricator's drawings the connection between the precast end section and the cast-in-place elements and any modifications to the plans required by substituting a precast concrete box culvert for the cast-in-place concrete box.

C. Design multiple-cell precast reinforced concrete box culverts and all custom designs according to the criteria used to develop the single-cell precast box culverts except use HS-25 live loading. Refer to ASTM C 1433.

D. Do not locate horizontal and vertical changes in alignment at a joint between precast segments of a precast concrete box culvert unless otherwise approved by the Engineer.

2.4 WATERSTOP

A. Provide waterstops as shown in the plans.

B. Refer to Section 03152.

2.5 GRANULAR BACKFILL BORROW

A. Refer to Section 02056.

2.6 DAMPPROOFING

A. Refer to Section 07111.

PART 3 EXECUTION

3.1 GENERAL

A. Structural Concrete: Refer to Sections 03055 and 03310.

B. Reinforcing Steel and Welded Wire: Refer to Section 03211.

3.2 CAST-IN-PLACE CONCRETE BOX CULVERT

A. Allow the base slab and footing to cure for 24 hours before constructing the remainder of the culvert.

B. Construct the side walls and top slab monolithically, unless the wall height exceeds 10 ft. 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 to anchor the top slab when the 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 the specified strength.

3.3 PRECAST CONCRETE BOX CULVERT

A. Refer to Section 02645.

B. Construct all cast-in-place concrete elements as shown in the plans and as modified in the approved fabricator's shop drawings.

3.4 DAMPPROOFING

A. Apply dampproofing to the full length of concrete box culverts when specified on the plans. Refer to Section 07111.

END OF SECTION

SECTION 02705

PAVEMENT CUTTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Saw or cut pavements, curb and gutter, sidewalk, and any appurtenances as required to provide a smooth surface to match.

1.2 RELATED SECTIONS

A. Section 02748: Prime Coat/Tack Coat

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 PAYMENT PROCEDURES

A. Department makes no separate payment for Pavement Cutting. Include in associated bid items.

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.

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 at no additional cost to the Department if the method of cutting does not produce a smooth, non-broken edge.

B. Make cuts so the defective surface can be removed where the edge of the existing surface is cracked, broken, or deteriorated.

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 surfacing when appropriate. Refer to Section 02748.

END OF SECTION

SECTION 02712

LEAN CONCRETE BASE COURSE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing a Lean Concrete Base Course.

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 6: Fine Aggregate for Portland Cement Concrete

B. AASHTO M 80: Coarse Aggregate for Portland Cement Concrete

C. AASHTO T 11: Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing

D. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

E. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

F. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide the Engineer with a written job-mix design for approval before placing lean concrete base course.
   1. Base the job-mix design, including water-cement ratio, on trial batch results that verify the concrete mix design strength.
   2. Do not change the job-mix design without written approval.
   3. Meet the requirements in Table 2 and Table 3.

B. Provide the Engineer with documentation from the manufacturer verifying that the curing compound is a wax-base product in accordance with Section 03390.

C. Provide results of aggregate suitability testing according to the requirements of this Section, article 2.2.

1.6 ACCEPTANCE

A. No strength tests are required for acceptance.

B. Thickness Requirements

1. Refer to Minimum Sampling and Testing Requirements
2. Core at locations identified by the Engineer to determine thickness-acceptance.
3. Determine pay factors from Table 1 with the following formula:

$$x_{avg} = \frac{\Sigma x}{n}$$

Where:

x = Determined length of core
n = Number of cores (1 per sublot =12,000 sq ft)
x_{avg} = Average length for entire project (lot)

4. Include all cores less than 3.5 inches in x_{avg} determination and also have a price adjustment under sublot. Refer to Table 1 for Payment Reductions for Thickness.

Table 1

Payment Reductions for Thickness	
Thickness	**Pay Factor (Project)**
$\bar{x} \geq 3.75$ inch	1.00
3.50 inch < $\bar{x}$ < 3.75 inch	0.90
3.00 inch < $\bar{x}$ < 3.50 inch	0.75
	Pay Factor (Sublot)
Sublot, 3.00 inch < x < 3.50 inch	0.75
Sublots, x < 3 inch	0.50 or replace as directed by the Engineer.

1.7 QUALITY ASSURANCE – STOCKPILES

A. Department requires new trial batches if the stockpile gradation changes from the job-mix gradation by more than the allowable variation as shown in Table 2.

B. Provide adequate supplies of aggregate and stockpiles for sampling and testing seven days before construction.

C. Make sufficient quantity of material available in the stockpiles to supply the mixing plant at full capacity and to provide continuous placing.

PART 2 PRODUCTS

2.1 CEMENT

A. Refer to Section 03055.

2.2 AGGREGATE

A. Meet the requirements of AASHTO M 80 and AASHTO M 6 for coarse and fine aggregate respectively.

B. Non-plastic. AASHTO T 90

C. Aggregate Job-Mix Gradation: AASHTO T 11, and AASHTO T 27
   1. Meet the requirements of Table 2.

Table 2

Aggregate - Lean Concrete Base Course		
	Job-Mix Gradation Band	**Allowable Variation From Job-Mix Gradation Target**
Sieve Size	**Percent Passing**	**Percent**
1½ inch	100	-
1 inch	85 - 100	-
¾ inch	50 - 100	± 8
⅜ inch	30 - 75	± 8
No. 4	25 - 60	± 8
No. 50	8 - 25	± 4
No. 200	0 – 9	± 3

2.3 WATER

A. Refer to Section 02752.

2.4 ADMIXTURES

A. Refer to Section 03055.

2.5 CURING COMPOUND

A. Refer to Section 03390.

2.6 EQUIPMENT

A. Refer to Section 02752.

2.7 JOB-MIX DESIGN

A. Design the job-mix in accordance with Table 3.

Table 3

Job-Mix Design Requirements			
Slump (inches)	Air Content (percent)	Minimum Cement Content (lbs/cu yd)	Minimum Design Compressive Strength (psi @ 7days)
2½ ± 1½	4.5 ± 1.5	255	750

PART 3 EXECUTION

3.1 CONSTRUCTION METHODS

A. Line and Grade Control: Refer to Section 02752.

B. Pre-Wetting Base Course:
   1. Moisten the subbase before placement.
   2. Keep at least 500 ft of subbase prepared ahead of the paver.

C. Formed paving option: Refer to Section 02752.

D. Batching materials: Refer to Section 02752.
   1. Do not exceed the water-cement ratio determined by the trial batches.

E. Placing lean concrete base: Refer to Section 02752.

F. Finishing:
   1. Screed the lean concrete base course to maintain line and grade within ⅜ inch in 10 ft.

3.2 CURING

A. Refer to Section 03390.

3.3 BOND BREAKER

A. Apply a second application of curing compound at 1 gal/200 ft^2 of surface within 48 hours before placing portland cement concrete pavement.

3.4 TRAFFIC CONTROL

A. Do not allow traffic or construction equipment on lean concrete base until 72 hours after placing.
   1. After 72 hours, trucks hauling portland cement concrete for pavement will be allowed provided that hauling does not cause damage.
   2. After seven days, legal loads may be hauled.
   3. Reduce the load or refrain from hauling if damage occurs.

B. Repair all damage at no additional cost to the Department.

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-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 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 TP 61: Determining the Percent of Fracture in Coarse Aggregate

K. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit a written report for approval for each aggregate class and source, a minimum of five working days prior to placement. Include the following:
   1. Aggregate suitability. Refer to this Section, Part 2, Products.
   2. Name of supplier and location of source.
   3. Maximum Dry Density and Optimum Moisture Content. Refer to AASHTO T 180, Method D.
   4. Job mix gradation including single values for each sieve size, No. 4 and finer, within the gradation limits of Table 2.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is in accordance with UDOT Minimum Sampling and Testing Requirements.

B. Type I Placement – Pavement Section includes placement for Curb or Curb and Gutter when in conjunction with placement for 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. Each sublot will be evaluated separately and not averaged 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 & 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 or B 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 sublot 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, B or C aggregate, Table 1.
   2. Adjust moisture content prior to 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. However, 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 directed by the Engineer. Rework unacceptable material at no additional cost to the Department.

G. Do not place additional material on any unaccepted layer.

H. Remove products found defective after placement and replace with acceptable products at no additional cost to the Department when directed by the Engineer.

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; meeting the requirements of Table 1.

Table 1

Aggregate Properties				
	Aggregate Class			
	A	**B**	**C**	
Dry Rodded Unit Weight	Not less than 75 lb/ft^3			AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic		PI $\leq$ 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	N/A	AASHTO TP 61

B. Establish the job mix (target) gradation for the ¾ inch sieve and finer within the gradation limits. The Job Mix Gradation Tolerance is the allowable deviation from the job mix (target) gradation on the applicable sieves. 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
¾ inch	70 - 85	±9.0
½ inch	65 - 80	±9.0
⅜ 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 having 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 prior to 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 ⅜ inch in 10 ft in any direction.
   1. Profile Tolerance — Correct any profile deviations greater than ⅜ 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 ⅜ inch.

E. Compaction: Maintain optimum moisture content ± 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 mixture of aggregate, mineral filler, additives, polymer-modified asphalt emulsion, and water.

B. Products and procedures for a cured mixture with a homogeneous appearance, a firm surface adhesion, and a skid resistant texture.
   1. Provide a micro-surface mixture that is capable of being spread in variable thickness cross-sections, ruts, scratch courses, and surfaces.

1.2 RELATED SECTIONS

A. Section 02746: Hydrated Lime

1.3 REFERENCES

A. AASHTO M 17: Standard Specification for Mineral Filler for Bituminous Paving Mixtures

B. AASHTO M 208: Standard Specification for Cationic Emulsified Asphalt

C. AASHTO T 11: Materials Finer Than 75 µm (No. 200) Sieve in Mineral Aggregate

D. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

E. AASHTO T 49: Penetration of Bituminous Materials

F. AASHTO T 53: Softening Point of Bitumen

G. AASHTO T 59: Testing Emulsified Asphalts

H. AASHTO T 96: Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

I. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

J. AASHTO T 176: Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

K. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

L. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

M. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer

N. ASTM D 6372: Standard Practice for Design, Testing and Construction of Micro-Surfacing

O. ISSA A 143 Guidelines (Current edition)

P. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide the Engineer with Mix Design 10 days prior to beginning construction.
   1. Meet requirements of this Section, article 2.6.

B. Provide the Engineer with the following for asphalt/polymer emulsion with job-mix design.
   1. Test report: Meet the requirements of this Section, article 2.1.
   2. A sample of asphalt/polymer emulsion with job-mix design.
   3. A certificate of analysis and compliance from the manufacturer for each shipment
   4. Target gradation for combined aggregate and mineral filler.
   5. Verify asphalt/polymer emulsion supplier adheres to UDOT Minimum Sampling and Testing Requirements Section 508 Asphalt Emulsion Quality Management Plan.

C. Provide test reports for mineral aggregate.
   1. Meet the requirements of this Section, article 2.2.

D. Provide verification that Hydrated Lime meets. Refer to Section 02746.

E. Provide a Manufacturer's Certificate of Compliance for Mineral Filler.

F. Provide calibration documentation for each mixing unit that includes an individual calibration for each material at various settings, which can be related to the machines metering devices.

G. To make 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 any changes in gradation are outside the gradation band allowed by the stockpile tolerance in Table 2.

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

A. Use a CSS-1h, quick-set polymer-modified asphalt emulsion conforming to AASHTO M 208; delete the cement mixing test requirements.

B. Mill or blend the polymer material into the asphalt or emulsifier solution prior to the emulsification process.

C. The asphalt/polymer emulsion must parallel the standard from an established infrared spectrum characterizing the asphalt/polymer emulsion.

D. Modified Emulsion Residue, meet Table 1:

Table 1

MODIFIED EMULSION RESIDUE		
TEST	**DESCRIPTION**	**SPECIFICATION**
AASHTO T 49	Penetration, 77°	40-90
AASHTO T 53	Softening point	135° Min
AASHTO T 59-modified (a)	F Residue by distillation	62% Min.
AASHTO T 316	Rotational Viscosity 275° F	650 CPS
(a) Modified distillation procedure: Heat emulsion residue to 270 ± 10 degrees F and maintain that temperature for 20 minutes. Perform the distillation within 60 ± 15 minutes		

2.2 MINERAL AGGREGATE

A. Use 100 percent manufactured mineral aggregates that meet the following requirements:
   1. Clean and free from organic matter, clay balls, or other detrimental substances.

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 sixty or greater. Refer to AASHTO T 176.
5. Minimum polishing value of 31. Refer to AASHTO T 278 and T 279.
   a. Performed on aggregate prior to crushing.
   b. Predominantly limestone or dolomite aggregates will not be accepted.

B. Select a job mix or target gradation within the gradation band. Base the mix design on this gradation. The percent passing each sieve will not vary by more than the stockpile tolerance and still remain within the gradation band after the target gradation has been submitted. Refer to AASHTO T 11, AASHTO T 27, and Table 2.

Table 2

Job-Mix Gradation Design Limits		
Sieve Size	Broad Band Gradation Percent Passing	Stockpile Tolerances
⅜	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

2.3 MINERAL FILLER

A. Use portland cement, hydrated lime, or aluminum sulfate as specified in AASHTO M 17

2.4 WATER

A. Use water that is potable and 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-surface mix, to improve the resulting finished surface, or to increase adhesion.
   1. Determine the initial additive quantities from the mix design for the micro-surface mix or individual materials.
   2. Use additives that are compatible with the other components of the mix.
   3. Obtain Engineer approval for use of additives.

2.6 JOB-MIX DESIGN

A. Design according to ASTM D 6372-99a.
   1. Show each ingredient amount:
      a) Residual asphalt cement content, within 7.5 ± 2 percent by dry total weight of aggregate.
      b) Aggregate gradation (target) within the job-mix gradation design limits in Table 2.
      c) Mineral filler, percentage by total dry weight of aggregate.
      d) Polymer modifier 2.5 percent minimum polymer solids based on the residual asphalt content.
   2. Identify additives as determined by design testing to control mix set times and adhesion.
      a) Provide acceptable percent limits for additives.
   3. Conform to the ISSA A143 specifications listed in Table 3.
   4. Use the same materials and aggregate gradation to be used on the project.

Table 3

ISSA Specifications		
ISSA TEST NO.	**DESCRIPTION**	**SPECIFICATION**
ISSA TB-139	Wet Cohesion @ 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	Wet-Track Abrasion Loss 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 Specific Gravity after 1,000 Cycles of 125 Pounds	5% Maximum 2.10 Maximum
ISSA TB-144	Classification Compatibility	11 Grade Points Minimum (AAA, BAA)
ISSA TB-113	Mix Time @ 77 degrees F	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 that will be a continuous flow mixing unit, able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, control setting additive, and water to a revolving multi-blade double shafted mixer and discharge 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. Equip the machine to allow the operator to have full control of the forward and reverse speed during applications of the micro-surfacing material.
    a) Use original equipment manufacturer design for the self-loading device, opposite side driver stations, and forward and reverse speed controls.
5. Use proportioning devices with individual volume or weight controls for proportioning each material, such as aggregate, mineral filler, emulsified asphalt, additive, and water to be added to the mix.
    a) Use proportioning devices with controls properly marked that calibrate and determine the material output at any time.

B. Use spreading equipment that will agitate and spread the mixture uniformly by means of twin-shafted paddles or spiral augers fixed in the spreader box.
1. Provide a front seal that results in no loss of mixture at the road contact point.
2. Provide an adjustable rear seal that acts as final strike-off.
3. Use a spreader box with the rear strike-off designed and operated to produce a free flow of uniformly consistent materials to the rear strike-off.
4. Use a spreader box with a suitable means provided to side shift the box to compensate for variations in the pavement geometry.
5. Provide a secondary strike-off to improve surface texture and with the same adjustments as the spreader box.
6. Use a rut filling spreader box specifically designed to fill ruts when filling ruts with an average depth greater than one-half inch.
    a) Apply micro-surface as a scratch-coat pass when required to fill ruts less than ½ inch at the direction of the Engineer.
    b) Make multiple passes with the rut filling spreader box for ruts of over ½ inch at the direction of the Engineer.
    c) Allow a 24-hour cure time after filling ruts before placing final micro-surfacing layer.

C. Calibrate each mixing unit in the presence of the Engineer as follows:
1. Prior to using on the project.
2. After repairs or as directed by the Engineer.

PART 3 EXECUTION

3.1 LIMITATIONS

A. Do not apply micro-surface during rain, when road surface moisture is present, or during other adverse weather conditions.

B. Do not apply micro-surface if either the pavement or air temperature is below 50 degrees F.

C. Do not apply micro-surface when the temperature is projected below 33 degrees F within 24 hours of placing micro-surface.

D. Cease micro-surface operations when the weather or other conditions prolong opening road surface to traffic beyond two hours.

E. Keep traffic off roadway surface until the micro-surface has cured.

3.2 STOCKPILE

A. Construct individual 500-ton stockpiles of micro-surface aggregates.
   1. Engineer approves stockpiles a minimum of one and a maximum of seven days prior to use.

B. Notify the Engineer a minimum of seven calendar days prior to micro-surface placement in order for the initial stockpiles to be sampled and tested for acceptance.

C. Obtain the Engineer's written acceptance of a stockpile prior to its use in micro-surface.

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 prior to applying micro-surface.

B. Allow un-sealed cracks to dry thoroughly prior to applying micro-surface when using water to clean the road surface.

C. Cover manholes, valve boxes, drop inlets, and other service utility entrances prior to surfacing.

3.4 APPLICATION

A. Pre-wetting the surface is allowed when required by local conditions by fogging ahead of the micro-surface box.
   1. Do not over apply causing free water to sit on the pavement in front of the micro-surface box.

B. Place micro-surface mix that meets the job-mix design.
   1. Control the ingredients proportions by 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. The emulsion submitted with the job-mix design will serve as the standard to assure the same emulsion is used throughout the project.
      a. Engineer may request a new job-mix design and re-approval of the micro-surfacing if large disparities occur.

C. Pass the mineral aggregate over a scalping screen prior to transfer to the micro-surfacing mixing machine to remove oversize material.

D. Carry a sufficient amount of micro-surface in all parts of the spreader so that full width and complete coverage is obtained with no streaks or narrow spots.
   1. Avoid overloading the spreader.

E. Apply micro-surface of proper consistency at an average rate of 24 to 30 lb/yd^2.
   1. Apply micro-surface for rut filling as required.

F. Do not add additional water for any reason once the mixture has been placed onto the road surface.

G. Remove and replace the micro-surface 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 with re-approved micro-surfacing materials and procedures.

3.5 TEST STRIP

A. Apply a test strip of at least 500 ft in length on the roadway before initial placement commences.
   1. Achieve initial set within 30 minutes and show no visual signs of distress when exposed to traffic action after curing for 2 hours.

2. Become part of the completed item if the above conditions are present and all other requirements are met.
3. Remove and replace the micro-surfacing at no expense to the Department if the test strip fails to meet the conditions stated above.

B. Make necessary adjustments if test strip does not pass.
1. Obtain approval from the Engineer prior to repeating 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. Place the micro-surface so the depth of each course does not exceed twice the maximum aggregate size.

B. Do not create build-up when constructing longitudinal and transverse joints.

C. Place micro-surface adjacent to concrete pavements or concrete curb and gutter with a straight longitudinal edge.
1. Do not allow over-lap in these areas.

D. Maintain straight lines at all locations.

E. Place micro-surface at side streets and intersections out to right-of-way line.

F. Use hand squeegees to spread micro-surface in areas that cannot be reached with micro-surface machine.
1. Lightly dampen areas prior to 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.

G. Use construction paper or comparable products so all beginning and ending joint lines from each construction pass are straight.

END OF SECTION

SECTION 02741

HOT MIX ASPHALT (HMA)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products and procedures for placing and compacting 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 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 323: Superpave Volumetric Mix Design

B. AASHTO R 35: Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)

C. AASHTO T 19: Unit Weights 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 Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

G. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

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 Bituminous Aggregate Mixtures

K. AASHTO T 255: Total Moisture Content of Aggregate by Drying

L. AASHTO T 304: Uncompacted Void Content of Fine Aggregate

M. AASHTO TP 61: Determining the Percentage of Fractured Particles in Coarse Aggregate

N. UDOT Materials Manual of Instruction

O. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit mix design at least 10 working days before paving according to Materials Manual of Instruction 960.

B. Submit verification that hydrated lime meets the requirements of Section 02746.

C. Submit verification that asphalt binder meets the requirements of Section 02745.

D. Changes in job mix targets:
   1. Submit a written request for a change in the job-mix gradation at least 12 hours before incorporating changes into production.
      a. Include documentation supporting correlation between suggested target changes and mix design volumetric requirements. Either or both Department acceptance and Contractor QC test data are acceptable.
      b. Field volumetric mix design verification consists of three sets of two gyratory specimens run at the new target gradation or asphalt binder content or both. The Department's previous acceptance tests are acceptable for field verification.

c. The Engineer and the Region Materials Engineer provide written concurrence of the verified field volumetric mix design if it meets the volumetric requirements.

d. 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. Allow at least four working days for verification.

2. The Department allows two minor target changes per project (non-retroactive) without penalty to contractor. Minor change is defined as a maximum of two screens being adjusted with each adjustment less than or equal to 5 percent of the total job mix gradation. All other changes will require volumetric mix design verification. The Department charges $1,000 for each additional minor target change.

3. The Department performs up to two volumetric mix design verifications at no cost to the Contractor. 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.

E. Submit a new laboratory volumetric mix design if changes occur in the aggregate source, asphalt binder source, or grade.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is in according to UDOT Minimum Sampling and Testing Requirements.

B. A lot equals the number of tons of HMA placed during each production day.

C. 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. 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 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.

e. 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.

D. Density and Thickness

1. Contractor obtains cores within two days after the pavement is placed. Materials Manual of Instruction 984.
   a. Engineer marks coring location for in-place density and joint density cores.
   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 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 including longitudinal joint density is 93.5 percent of Maximum Specific Gravity for projects where the design overlay thickness is greater than 2 inches.
   b. The target for in-place density including longitudinal joint density is 92.5 percent of Maximum Specific Gravity for projects where design overlay thickness is less than or equal to 2 inches.
   c. Use the average of the Maximum Specific Gravity tests for each lot.
   d. Acceptance for in-place density may be based on establishing a rolling pattern for bridge decks, utility work, traffic signals, detours, lane leveling, driveways, etc, or small projects with plan quantities less than 3,000 tons.
3. Thickness Requirements
   a. The Department accepts a lot for thickness when:
      1) The average thickness of all sublots is not more than ½ inch greater nor ¼ inch less than the total thickness specified.
      2) No individual sublot shows a deficient thickness of more than ⅜ 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 +½ 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. Thickness acceptance for thin lift projects of 2 inches or less consists of checking thickness regularly with a depth probe during placement and taking corrective action as necessary.

E. The Department applies Incentives/Disincentives for Gradation/Asphalt Content, In-Place Density, and Longitudinal Joint 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 Table 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. Incentive for Joint Density is $0.20 per linear foot of longitudinal joint for each lift when the average of all joint densities is within the density limits of Table 2 with no single determination less than 4 percent below in-place target density.
7. The following work is not eligible for incentive.
   a. Utility work, traffic signals, detours, lane leveling, driveways, etc.
   b. Small projects with plan quantities of HMA less than 3,000 tons.
8. The Department will reject the lot if the PT is less than 60 percent.

F. The Department rejects the lot if the PT for any individual measurement is less than 60 percent.
1. The Engineer may accept a reject lot based on an Engineering analysis.
   a. A $25 per ton price reduction 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, driveways, etc., or small projects with plan quantities less than 3,000 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 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 Gradation, Asphalt Binder Content, and Density	
PT Based on Min. Four Samples	**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 2

Upper and Lower Limit Determination	
Parameter	**UL and LL**
¾ inch sieve for 1 inch HMA ½ inch sieve for ¾ inch HMA ⅜ inch sieve for ½ inch HMA No. 4 sieve for ⅜ inch HMA	Target Value ± 6.0%
No. 8 sieve	Target Value ± 5.0%
No.50 sieve	Target Value ± 3.0%
No. 200 sieve	Target Value ± 2.0%
Asphalt Binder Content	Target Value ± 0.35%
Density	Lower Limit: Target Value - 2.0% Upper Limit: Target Value + 3.0%

Table 3

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 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 1.4 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 place accuracy, which will be 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.**	**Category 1**	**Category 2**
One Fractured Face	AASHTO TP 61	95% min.	85% min. (1 inch and ¾ inch) and 90% min. (½ inch and ⅜ inch)
Two Fractured Face	AASHTO TP 61	90% min.	80% min. (1 inch and ¾ inch) and 90% min. (½ inch and ⅜ inch)
Fine Aggregate Angularity	AASHTO T 304	45 min.	45 min.
Flakiness Index	UDOT MOI 933 (Based on ⅜ inch sieve and above)	17% max.	17% max.
L.A. Wear	AASHTO T 96	35% max.	40% max.
Sand Equivalent	AASHTO T 176 (Pre-wet method)	60 min.	45 min.
Plasticity Index	AASHTO T 89 and T 90	0	0
Unit Weight	AASHTO T 19	min. 75 lb/cu ft	min. 75 lb/cu ft
Soundness (sodium sulfate)	AASHTO T 104	16% max. loss with five cycles	16% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T 112	2% max	2% max.
Natural Fines	N/A	0%	10% max.
Category 1: National Highway System and Truck Routes - Table 9. **Category 2: All Other Routes**			

C. Meet gradation requirements in Table 6.

Table 6

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)					
Sieve Size		**1 inch**	**¾ inch**	**½ inch**	**⅜ inch**
Control Sieves	**1½ inch**	100.0			
	1 inch	90.0 - 100.0	100.0		
	¾ inch	<90	90.0 - 100.0	100.0	
	½ inch		<90	90.0 – 100.0	100.0
	⅜ 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 (OPTIONAL)

A. No asphalt binder grade adjustment is necessary when reclaimed asphalt pavement (RAP) is limited to 15 percent by total weight of the hot mix.

B. Adjust asphalt binder grade according to AASHTO M 323 when RAP content is between 15 to 25 percent of the total weight of the hot mix.
   1. Select one grade softer than the grade specified. Do not select any grades lower than PG XX-34.

C. Adjust asphalt binder grade according to AASHTO M 323 Appendix A when RAP content exceeds 25 percent.
   1. Obtain Engineers approval to exceed 25 percent.
   2. Use RAP from a single source.
   3. Provide test reports indicating that the PG grade of the recovered asphalt binder is consistent throughout the stockpile.
   4. Limit RAP to 30 percent of the total weight of the hot mix.

D. RAP aggregate is required to meet Table 5 with exception of Sand Equivalent AASHTO T 176.

2.5 VOLUMETRIC 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. The Department Region Materials Lab verifies the Volumetric Mix Design. UDOT Materials Manual of Instruction 960
   1. Do not begin paving until verification is complete.

Table 7

Volumetric Design Gyrations				
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}: Maximum specific gravity of mix. (Rice Method)
** 67 percent specified 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} at SSD. Equation based on percent of total mix.	12.5 % - 13.5 % for 1 inch 13.5 % - 14.5 % for ¾ inch 14.5 % - 15.5 % for ½ inch 15.5 % - 16.5 % for ⅜ inch
Hamburg Wheel Tracker UDOT MOI 990	Category 1 Roads: Maximum 10 mm impression at 20,000 passes. Category 2 Roads: Maximum 10 mm impression at 10,000 passes

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. Insure lime slurry equipment is operating at all times when using Method A.
      a. Cease production if hydrated lime slurry treatment is interrupted.
      b. Engineer may require marination of the aggregate/hydrated lime mixture in the stockpile, Method B, if production continues without hydrated lime slurry treatment.

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 identified limits for mixing and compaction as defined on Volumetric Mix Design Verification Letter.
   1. Department rejects materials heated over the identified limits.
   2. Remove all material rejected by the Department for overheating.

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. Provide asphalt binder storage tanks that:
   1. Calibrate tanks so the quantity of material remaining in the tank can be determined at any time.
   2. Provide a positive means of sampling the asphalt binder from the tanks.

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 4.5 percent
   3. VMA at N_{des} averaged for each lot are not within Target Value ± 1.25 percent

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.

3.4 CONTRACTOR INITIATED CHANGES IN MIX DESIGN

A. Changes in job mix gradation:
   1. Submit a written request for a change in a job-mix gradation. Refer to this Section, article 1.5.

3.5 LABORATORY CORRELATION

A. Perform split-sample, paired *t*-testing with the Department based on project quality control testing using UDOT 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 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.

3.6 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. 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. Allow sufficient cure time for prime coat/tack coat before placing HMA. Refer to Section 02748.

3.7 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. Adjust the production of the mixing plant and material delivery until a steady paver speed is maintained.

C. Offset longitudinal joints 6 to 12 inches in succeeding courses.
   1. Place top course joint within 1 ft of the centerline or lane line.
   2. Tack the longitudinal edge before placing the adjacent pass if the previous pass has cooled below 175 degrees F.

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 yd^2, irregular areas, or for miscellaneous construction such as detours, sidewalks, and leveling courses.

3.8 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.

3.9 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 acceptable to the Engineer for all equipment and hand tools used to mix, haul, and place the HMA.

C. Place between April 15, and October 15, and when the air temperature in the shade and the roadway surface temperature are above 50 degrees F.
   1. The Department determines and provides written approval if it is acceptable to place outside the above limits.

Table 9

Category 1 Roads		
Route	**Beginning**	**Ending**
1-15	Arizona State Line	Idaho State Line
1-70	Jct I-70 - Cove Fort	Colorado State Line
1-80	Nevada State Line	Wyoming State Line
1-84	Idaho State Line	Jct I-80 – Coalville
1-215	Jct I-80 - Parleys Canyon	Jct I -15 - North Salt Lake
US-6	Nevada State Line	Jct US-50 – Delta
US-6	Jct I-15 - Spanish Fork	Jct I-70 - Green River
US-40	Jct I-80 - Park City	Colorado State Line
US-50	Jct US-6 - Delta	Jct I-15 – Holden
US-89	Arizona State Line	Jct I-70 – Sevier
US-89	Jct I-70 - Salina	Jct SR-28 - Gunnison
US-89	Jct US-6 - Spanish Fork	Jct SR-73 – Lehi
US-89	SR-71 - Draper	Jct SR-269 - 5th and 6th South
US-89	Jct I-15 - North Salt Lake	Junction I-15 Bountiful
US-89	Jct I-15 Farmington	Jct I-84 – Uintah
US-89	Jct I-84 - Uintah	Jct US-91 Brigham City
US-89	Jct US-91 - Logan	Idaho State Line
US-91	Jct I-15 - Brigham City	Idaho State Line
US-189	Jct I-15 - South Provo	Jct US-40 - Heber City
US-191	Arizona State Line	Jct I-70 - Thompson
US-491	Jct US-191 - Monticello	Colorado State Line
SR-9 - Zions Park	Junction I-15	Jct US-80 - Mt. Carmel Jct
SR-10 - Castle Valley	Jct I-70 - Fremont Jct	Jct US-6 – Price
SR-12 - Bryce Canyon	Jct US-89 - Panguitch	Jct SR-63 - Bryce Canyon
SR-13- Box Elder Co	Jct US-91 Brigham City	Jct SR-83 - Corrine
SR-26 – Riverdale Road	Jct 126-Roy	Jct US-89 – Ogden
SR-28 - Levan Desert	Jct US-89 - Gunnison	Jct I-15 - South Nephi
SR-30 – Box Elder/Cache Co	Jct I-15 - Riverside	Jct US-89 Logan
SR-31 - Huntington	Mile Post 33	Mile Post 49
SR-36 - Tooele Access	Jct entrance - Tooele Army Depot	Jct I-80 - Tooele Interchange
SR-39 - 12 th Street Ogden	Mile Post 0	Jct SR-203 - Harrison Blvd
SR-52 - 8th North, Orem	Jct 1-15 - Orem	Jct US -189 - Olmstead Jct
SR-57 - Orangeville Bypass	Jct SR-10 - Hunter Power Plant	Entrance – Wilberg Coal Mine
SR-67 - Legacy Highway	Jct I-215	Jct. I-15
SR-71 - 7th and 9th East Street, Salt Lake City	Jct SR-209 - 90th South Street	Jct SR-186 - 4th South Street
SR-73 - Lehi Connection	Jct I-15 - South Lehi	Jct US-89 - South Lehi

Category 1 Roads		
Route	**Beginning**	**Ending**
SR-79 – 30th and 31st Street Ogden	Jct SR-126	Jct SR-203 - Harrison Blvd.
SR-83- Thiokol Road	Jct SR-13- Corrine	MP 25 Lampo Junction
SR-96 - Scofield Access	Mile Post 3	Mile Post 4
SR-101- Cache Co.	Jct US-91 Wellsville	Jct SR-65 – Hyrum
SR-108 – Antelope Drive/ Midland Drive	Jct I-15 Mile Post 0	Jct 126 - West Haven
SR-104 20th 21st Street Ogden	Jct SR-126	Jct SR-204
SR-111 - Bacchus Highway	Jct SR-48 - Bingham Highway	Jct SR-201 - 21st South Expressway
SR-126 1900 West	Jct SR-108 Layton	Jct US-89 - So Willard.
SR-134 - 2700 North	Jct I-15 - North Ogden, Exit 352	Jct US-89 - North Ogden
SR-152 - Van Winkle Expressway	Jct SR-71 - 9th East Street	Jct I-215 - East (Exit 8)
SR-154 - Bangerter Highway	Jct I-15 – Draper	Jct I-80 - Salt Lake Intl Airport
SR-165 Cache Co.	Jct SR-101 – Hyrum	Jct US-91 – Logan
SR-171 - 33rd and 35th South, Salt Lake City	Jct SR-172 - 56th West Street	Jct I-215 - East, Exit 3
SR-172 - 56th West Street Salt Lake City	Jct 6200 South – Kearns	Jct I-80 - International Center
SR-186 Foothill Blvd	Jct SR-71 - 7th East Street, SLC	Jct I-215 - East (Exit 1)
SR-190 - Big Cottonwood	Jct I 215 - East, Exit 7, SLC	Jct SR-210 - Little Cottonwood
SR-193 – East Hill Field Road	Jct SR-126 – Clearfield	Jct US-89 – Layton
SR-201 - 21st South Expressway	Jct I-80 - Lake Point	Jct I-15 - South Salt Lake
SR-203 - Harrison Blvd	Jct US-89 - South Ogden	Jct SR-39 - 12th Street
SR-204- Wall Ave	Jct SR-26 – Riverdale Road	Jct US-89 - Harrisville
SR-209 - 90th & 94th South	Jct SR-68 - Redwood Road (SLC)	Jct SR-210 - Little Cottonwood
SR-210 - Little Cottonwood	Jct SR-190 - Big Cottonwood	Jct SR-209 - 90th and 96th South
SR-232- Hill Field Road	Jct SR-126 – Layton	Hill Air Force Base
SR-264 - Skyline Mine Road	Mile Post 12	Mile Post 15
SR-265 - University Parkway	Jct I-15 - Exit 272	Jct I-215 - East, Exit 5
SR-266 - 45th & 47th South Taylorsville	Jct I-215 - West, Exit 15	Jct I-215 - East, Exit 5
SR-269 - 5th & 6th South Salt Lake City	Jct I-215, Exit 310	Jct SR-71- 7th East Street

END OF SECTION

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 304: Uncompacted Void Content of Fine Aggregate

L. AASHTO T 308: Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Oven

M. AASHTO TP 4: Method for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

N. ASTM D 4791: Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

O. ASTM D 5821: Determining the Percentage of Fractured Particles in Coarse Aggregate

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. Certify that the mix meets the gradation and asphalt binder requirements of Table 2, Aggregate Gradation and Job Mix Design Requirements. Submit design data sheet to support. 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: CSS-1 or SS-1.

2.2 AGGREGATE

A. Refer to Section 02745 and Section 02741 except for Aggregate Properties Table.

B. Use Table 1 following for Aggregate Properties.

Table 1

Aggregate Properties		
Properties	**Test Method**	**Test Requirements**
One Fractured Face	ASTM D 5821	N/A
Two Fractured Face	ASTM D 5821	90% Min.
Fine Agg. Angularity	AASHTO T 304	45 Min.
Flat and Elongated 1:3 Ratio	ASTM D 4791 (Based on ⅜ inch and above)	20% 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		
Sieve Size		**Percent**
Control Sieves	½ inch	100.0
	⅜ inch	90.0 - 100.0
	# 4	< 90.0
	# 8	32.0 - 67.0
	# 200	2.0 - 10.0

2.3 HYDRATED LIME

A. Use a minimum of one percent hydrated lime.

B. Refer to Section 02746.

2.4 VOLUMETRIC DESIGN REQUIREMENTS

A. Hot Mix supplier is responsible for satisfying all requirements for Superpave Volumetric Mix Design:
   1. Use a laboratory qualified by UDOT Central Quality Assurance Section in the use of the Superpave Gyratory Compactor. AASHTO TP 4.
   2. Certify that the mix design meets requirements for Volumetric Mix Design outlined in this section.
   3. Project Engineer may accept the Volumetric Mix Design from data submitted with the proposed mix design or from a previous mix design. The Region Materials Engineer reserves the right to verify any mix design submitted.

B. Comply with requirements in Table 3.
   1. Obtain Mixing Temperature from the Engineer.

Table 3

Superpave Volumetric Mix Design		
Compaction Stage	**Number of Gyrations (N)**	**% of G_{mm} (AASHTO T209)**
Initial	6	$\leq$ 91.5
Design	50	$\geq$ 98.5
Maximum	75	$\leq$ 100.0

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Refer to Section 02741, Part 3.

B. Refer to Section 02748.

3.2 COMPACTION

A. Establish a rolling pattern to obtain maximum density without over-stressing the pavement.

3.3 ASPHALT EMULSION

A. Apply the flush coat at a uniform rate of 0.10 gal/yd^2 undiluted emulsion or 0.15 gal/yd^2 2:1 diluted emulsion. Note: 2:1 diluted emulsion represents two parts undiluted emulsion and one part water.

END OF SECTION

SECTION 02745

ASPHALT MATERIAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphalt materials

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 81: Cut-Back Asphalt (Rapid-Curing Type)

B. AASHTO M 82: Cut-Back 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 320: Performance Graded Asphalt Cement

G. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)

H. AASHTO T 44: Solubility of Bituminous Materials

I. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup

J. AASHTO T 49: Penetration of Bituminous Materials

K. AASHTO T 50: Float Test for Bituminous Materials

L. AASHTO T 51: Ductility of Bituminous Materials

M. AASHTO T 59: Testing Emulsified Asphalt

N. AASHTO T 201: Kinematic Viscosity of Asphalts

O. AASHTO T 228: Specific Gravity of Semi-Solid Bituminous Materials

P. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)

Q. AASHTO T 300: Force Ductility of Bituminous Materials

R. AASHTO T 301: Elastic Recovery Test of Bituminous Materials by Means of a Ductilometer

S. AASHTO T 313: Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)

T. AASHTO T 314: Determining the Fracture Properties of Asphalt Binder in Direct Tension

U. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

V. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer

W. ASTM D 92: Flash and Fire Points by Cleveland Open Cup

X. ASTM D 1190: Concrete Joint Sealer, Hot-Applied Elastic Type

Y. ASTM D 2006: Method of Test for Characteristic Groups in Rubber Extender and Processing Oils by the Precipitation Method.

Z. ASTM D 2007: Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

AA. ASTM D 2026: Cutback Asphalt (Slow-Curing Type)

BB. ASTM D 3405: Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

CC. ASTM D 4402: Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

DD. ASTM D 5329: Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

EE. ASTM D 5801: Toughness and Tenacity of Bituminous Materials

FF. California Test Methods

GG. UDOT Materials Manual of Instruction

HH. UDOT Minimum Sampling and Testing Guide

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Supply a vendor-prepared bill of lading showing the following information 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 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 types or grades than those specified.

1.7 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.

1.8 PAYMENT PROCEDURES

A. Price adjustments for asphalt cement and liquid asphalt including chip-seal emulsions and cut-backs:
   1. Standard department procedures governs price adjustments made where asphalt material does not conform to the specifications
      a. The Engineer may order the removal of any or all the defective asphalt material if the price adjustment exceeds 30 percent.
      b. The pay factor for such material is 0.50 when allowed to remain in place.

B. Price adjustments for Performance Graded Asphalt Binder (PGAB):
   1. Standard department PGAB management plan governs price reductions or removal of material where the binder does not conform to the specifications.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADED ASPHALT BINDER (PGAB)

A. Supply PGABs under the Approved Supplier Certification (ASC) System. Refer to the UDOT Minimum Sampling and Testing Guide, Section 509, Asphalt Binder Management Plan.

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 Tables 1, 2, 3, 4, 5, 6, 7, and 8 for all PGABs having algebraic differences equal to or greater than 92 degrees between the high and low design temperatures.

Table 1

PG58-34		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@58°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@16°C, kPa	5000 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 2

PG64-28		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@22°C, kPa	5000 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 3

PG64-34		
Original Binder		
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.
RTFO Residue, AASHTO T-240		
Dynamic Shear Rheometer, AASHTO T 315	@64°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@19°C, kPa	5000 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 4

PG70-22		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	65 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@28°C, kPa	5000 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 5

PG70-28		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@25°C, kPa	5000 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 6

PG70-34		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@70°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	75 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@22°C, kPa	5000 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 7

PG76-22		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	70 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@ 31°C, kPa	5000 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 8

PG76-28		
Original Binder		
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.
RTFO Residue, AASHTO T 240		
Dynamic Shear Rheometer, AASHTO T 315	@76°C, G*/sinδ, kPa	2.20 Min.
Elastic Recovery, AASHTO T 301 mod (a)	%	75 Min.
PAV Residue, 20 hours, 2.10 MPa, 100 °C, AASHTO R 28		
Dynamic Shear Rheometer, AASHTO T 315	@28°C, kPa	5000 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) with values as detailed below.

AC - 2.5	AC - 5	AC - 10	AC - 20
50+	25+	15+	5+

B. As specified for cationic and anionic emulsified asphalt.
   1. All standard Slow Setting (SS, CSS), Medium Setting (MS, CMS), and Rapid Setting (RS, CRS) grades; inclusive of all High-Float designations (HF).
   2. Supply under the Approved Supplier Certification System (ASC).
   3. Meet AASHTO M 208 and M 140.

C. Conform to the requirements of one of these tables:
   1. Table 9: Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)
   2. Table 10: Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)
   3. Table 11: Cationic Medium Setting Emulsified Asphalt (CMS-2S)
   4. Table 12: High Float Medium Setting Emulsified Asphalt (HFMS-2)
   5. Table 13: High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P)
   6. Table 14: High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2SP)
   7. Table 15: High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P).
   8. Table 16: Setting Cationic Rapid Emulsified Asphalt (CRS-2A, B)

D. Curing cut-back asphalt:
   1. Refer to ASTM D 2026 as specified for slow curing (SC).
   2. Refer to AASHTO M 82 as specified for medium curing (MC).
   3. Refer to AASHTO M 81 as specified for rapid curing (RC).

E. Conform to requirements for Emulsified Asphalt Pavement Rejuvenating Agent:
   1. Table 17: Type A
   2. Table 18: Type B
   3. Table 19: Type B Modified
   4. Table 20: Type C
   5. Table 21: Type D

Table 9

Cationic Rapid Setting Emulsified Polymerized Asphalt (CRS-2P)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity , SF, 140ºF (60ºC), s (Project-site Acceptance/Rejection Limits)	T59	100	400
Settlement (a) 5 days, percent	T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	T 59		
Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosucinate, percent	T 59	40	
Particle Charge Test	T 59	Positive	
Sieve Test, percent	T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		68	
Residue from Distillation Test			
Penetration, 77ºF (25ºC), 100 g, 5 s, dmm	T 49	80	150
Ductility, 39.2ºF (4ºC), 5 cm/min, cm Toughness, lb-in Tenacity, lb-in	T 51 ASTM D 5801 ASTM D 5801	35 75 50	
Solubility in trichloroethylene, percent	T 44	97.5	

The test requirement for settlement may be waived when the emulsified asphalt is used in less than five-days or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.

(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 ± 5ºF (177±3ºC) maximum temperature to be held for 15 minutes.

Modify the asphalt cement prior to emulsification.

Table 10

Latex Modified Cationic Rapid Setting Emulsified Asphalt (LMCRS-2)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122ºF (50ºC), s (Project Site Acceptance/Rejection Limits)	T59	140	400
Settlement (a) 5 days, percent	T 59		5
Storage Stability Test (b) 1 d, 24 h, percent	T 59		1
Demulsibility (c) 35 ml, 0.8% sodium dioctyl Sulfosucinate, percent	T 59	40	
Particle Charge Test	T 59	Positive	
Sieve Test, percent	T 59		0.3
Distillation			
Oil distillate, by volume of emulsion, percent			0
Residue (d), percent		65	
Residue from Distillation Test			
Penetration, 77ºF (25ºC), 100 g, 5 s, dmm	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; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.
(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 ± 5ºF (177±3ºC) maximum temperature to be held for 15 minutes.
(e) CA 332 (California Test Method)

Co-mill latex and asphalt during emulsification

Table 11

Cationic Medium Setting Emulsified Asphalt (CMS-2S)		
Tests	**AASHTO Test Method**	**Specification**
Emulsion		
Viscosity, SF, 122ºF (50ºC), s	T 59	50 - 450
Percent residue	T 59	60 min
Storage Stability Test, 1d, 24h, percent	T 59	1 max
Sieve, percent	T 59	0.10 max
Particle charge	T 59	Positive
Oil Distillate, percent by volume of emulsion	T 59	5-15
Residue		
Penetration, 77ºF (25ºC), 100g, 5 sec, dmm	T 59	100-250
Solubility, percent	T 59	97.5 min.

Table 12

High Float Medium Setting Emulsified Asphalt (HFMS-2)			
Tests	**AASHTO Test Method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122°F (50°C), s (Project Site Acceptance/Rejection Limits	T59	70	300
Storage Stability Test, 1d, 24 h, percent	T59		1.0
Sieve Test , percent	T59		0.1
Distillation	T59		
Oil Distillate, by volume of emulsion, percent	T59	NA	NA
Residue, percent	T59	65	
Residue from Distillation Test			
Penetration, 77°F (25°C), 100g, 5 s, dmm	T49	50	200
Float Test, 140°F (60°C), s	T50	1200	
Solubility in Trichloroethylene, percent	T44	97.5	
Ductility, 77°F (25°C) 5cm/min, cm	T51	40	

Table 13

High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2P) (a)			
Tests	**AASHTO Test method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122ºF (50ºC), s (Project Site Acceptance/Rejection Limits)	T 59	100	450
Storage Stability Test, 1 d, 24 h, percent	T 59		1.0
Sieve Test, percent	T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		7
Residue (b), percent	T 59	65	
Residue from Distillation Test			
Penetration, 77ºF (25ºC), 100 g, 5 s, dmm	T 49	70	300
Float Test, 140ºF (60ºC), s	T 50	1200	
Solubility in trichloroethylene, percent	T 44	97.5	
Elastic Recovery, 77ºF (25ºC), percent	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 a minimum of 3.0% polymer by weight of the asphalt cement prior to 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 a minimum of 24 hours.

(b) Determine the distillation by AASHTO T 59, with modifications to include a 350± 5ºF (177±3ºC) maximum temperature to be held for 15 minutes.

Table 14

High Float Medium Setting Emulsified Polymerized Asphalt (HFMS-2SP) (a)			
Tests	**AASHTO Test method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF, 122ºF (50ºC), s (Project Site Acceptance/Rejection Limits)	T 59	50	450
Storage Stability Test, 1 d, 24 h, percent	T 59		1
Sieve Test, percent	T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		7
Residue (b), percent	T 59	65	
Residue from Distillation Test			
Penetration, 77ºF (25ºC), 100 g, 5 s, dmm	T 49	150	300(c)
Float Test, 140ºF (60ºC), s	T 50	1200	
Solubility in trichloroethylene, percent	T 44	97.5	
Elastic Recovery(d), 77ºF (25ºC), percent	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 a minimum of 3.0% polymer by weight of the asphalt cement prior to 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 a minimum of 24 hours.

(b) Determine the distillation by AASHTO T 59, with modifications to include a 350± 5ºF (177±3ºC) maximum temperature to be held for 15 minutes.

(c) Emulsified Asphalt (HFMS-2SP) with a residual penetration greater than 300 dmm may be used with Cold Bituminous Pavement (Recycle) to address problems with cool weather or extremely aged existing pavement when approved by the Engineer.

(d) Report only when penetration is greater than 300 dmm.

Table 15

High Float Rapid Setting Emulsified Polymerized Asphalt (HFRS-2P) (a)			
Tests	**AASHTO Test method**	**Min.**	**Max.**
Emulsion			
Viscosity, SF @ 122ºF (50ºC), s (Project Site Acceptance/Rejection Limits)	T 59	50	450
Storage Stability Test (b) 1 d, 24 h, percent	T 59		1
Demulsibility 0.02 N Ca Cl_2, percent	T 59	40	
Sieve Test, percent	T 59		0.1
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		3
Residue (b), percent	T 59	65	
Residue from Distillation Test			
Penetration, 77ºF (25ºC), 100 g, 5 s, dmm	T 49	70	150
Float Test, 140ºF (60ºC), s	T 50	1200	
Solubility in trichloroethylene, percent	T 44	97.5	
Elastic Recovery, 77ºF (25ºC), percent	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 a minimum of 3.0% polymer by weight of the asphalt cement prior to 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 a minimum of 24 hours.

(b) Determine the distillation by AASHTO T 59, with modifications to include a 350 ± 5ºF (177±3ºC) maximum temperature to be held for 15 minutes.

Table 16

Cationic Rapid Setting Emulsified Asphalt (CRS-2A,B)			
Tests	**AASHTO Test Method**	**Min**	**Max**
Emulsion			
Viscosity, SF, 122ºF (50ºC), s (Project Site Rejection/Acceptance Limits)	T 59	140	400
Storage stability test, 24 h, percent	T 59		1
Demulsibility, 35 mL 0.8 percent Sodium Dioctyl Sulfosucinate, percent	T 59	40	
Particle charge test	T 59	Positive	
Sieve test, percent	T 59		0.10
Distillation			
Oil distillate, by volume of emulsion, percent	T 59		0
Residue, percent	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 3ºC of grade.			

Table 17

Emulsified Type A Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77ºF (25ºC), 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, 140ºF (60ºC), mm^2/s	ASTM D 4402	150 - 300
Flash Point, COC, ºF (ºC)	AASHTO T 48	385 Min.
Asphaltenes, percent W	ASTM D 2006-70	0.4 Min. 0.75 Max.
Maltene Distribution Ratio $(PC + A_1)/(S + A_2)$ (d)	ASTM D 2006-70	0.3 Min. 0.6 Max
Saturated Hydrocarbons, S (d)	ASTM D 2006-70	21 Min. 28 Max.
PC/S Ratio (d)	ASTM D 2006-70	1.5 Min.

(a) AASHTO T 59, Evaporation Test, modified as follows: Heat a 50 gram sample to 300ºF 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 18

Emulsified Type B Asphalt Pavement Rejuvenating Agent Concentrate		
Tests	**Test Method**	**Limits**
Viscosity, SF, 77ºF (25ºC), 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 @ 140ºF (60ºC), mm^2/s	AASHTO T 201	2500-7500
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC	ASTM D 92	204ºC, 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 ±5ºF (149±3ºC) 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 77ºF (25ºC) 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 19

Emulsified Type B Modified Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77ºF (25ºC), 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) 275ºF (135ºC), cP	ASTM D 4402	150 – 300
Penetration, 77ºF (25ºC), dmm	AASHTO T 49	180 Min.
Solubility in 1,1,1 Trichloroethylene, percent	AASHTO T 44	98 Min.
Flash Point, COC, ºF (ºC)	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±5ºF (149± 3ºC) 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 77ºF (25ºC) 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. $\geq$ 50 rpm with a #21 spindle, 7.1 g residue, at $>$ 10 torque

As required by the Asphalt Emulsion Quality Management Plan, UDOT Minimum Sampling and Testing Guide, Section 508) the supplier certifies that the base stock contains a minimum of 15% by weight of Gilsonite Ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.

Table 20

Emulsified Type C Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77ºF (25ºC), 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, 275ºF (135ºC), mm^2/s	AASHTO T 201	475-1500
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	232ºC, 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± 5ºF (149 ± 3ºC) 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 77ºF (25ºC) 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, UDOT Minimum Sampling and Testing Guide, Section 508), the supplier certifies that the base stock contains a minimum of 10% by weight of Gilsonite ore. Use the HCL precipitation method as a qualitative test to detect the presence of Gilsonite.		

Table 21

Emulsified Type D Asphalt Pavement Rejuvenating Agent Concentrate		
Property	**Test Method**	**Limits**
Viscosity, SF, 77ºF (25ºC), 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, 140ºF (60ºC), cm^2/s	AASHTO T 201	300-1200
Viscosity, 275ºF (135ºC), mm^2/s	AASHTO T 201	300 Min.
Modified Torsional Recovery (a) percent	CA 332 (Mod)	40 Min.
Toughness, 77ºF (25ºC), in-lb	ASTM D 5801	8 Min.
Tenacity, 77ºF (25ºC), 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±5ºF (149±3ºC) maximum temperature to be held for 15 minutes.		

2.3 HOT-POUR CRACK SEALANT FOR BITUMINOUS CONCRETE

A. Combine a homogenous blend of materials to produce a sealant meeting properties and tests in Table 22.

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. 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 22

Hot-Pour Bituminous Concrete 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 bituminous concrete or softening or other harmful effects on the bituminous concrete.		
Material Handling:	Follow the manufacturer's safe heating and application temperatures.		
Test Method	**Property**	**Minimum**	**Maximum**
AASHTO T 51	Ductility, modified, 1cm/min, 39.2ºF (4ºC), cm	30	
UDOT method 967	Cold Temperature Flexibility	no cracks	
AASHTO T 300 (a)	Force-Ductility, lb force		4
ASTM D 5329	Flow 140ºF (60ºC), 5 hrs 75º angle, mm		3
ASTM D 3405 (b)	Tensile-Adhesion, modified	300%	
AASHTO T 228	Specific Gravity, 60ºF (15.6ºC)		1.140
ASTM D 5329	Cone Penetration, 77ºF (25ºC), 150 g, 5 sec., dmm		90
ASTM D 5329	Resilience, 77ºF (25ºC), 20 sec., percent	30	
ASTM D 4402	Viscosity, 380ºF (193.3ºC), SC4-27 spindle, 20 rpm, Cp		2500
ASTM D 5329	Bond as per ASTM D 1190, Section 6.4		Pass

(a) Maximum of 4 lb force during the specified elongation of 30 cm @ 1 cm/min, 39.2ºF (4ºC).
(b) Use ASTM D 3405, Section 6.4.1. Delete bond and substitute tensile-adhesion test in accordance to 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 Asphaltic-Concrete Mixtures

D. ASTM C 1602: Mixing Water Used in the production of Hydraulic Cement Concrete

E. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Verification that the supplier is pre-qualified.

1.6 QUALITY ASSURANCE

A. Prequalification: Hydrated Lime, through UDOT Quality Management Plan for Hydrated Lime, Section 510.

PART 2 PRODUCTS

2.1 HYDRATED LIME

A. Hydrated Lime: Meet AASHTO M 303, Type I, as specified.
   1. Conform physical requirements to ASTM C 1097, subparagraph d.1.
   2. Use test method ASTM C 110, paragraph 5.4.

2.2 WATER

A. Use potable water or water meeting ASTM C 1602.

PART 3 EXECUTION

3.1 APPLICATION

A. Add hydrated lime to all asphalt pavement mixes.
   1. Add the determined quantity of lime, following mix design.
   2. Base the amount of hydrated lime used on the dry weight of the aggregate.
   3. Use either Method A or B, unless Method B is called for in the bid schedule.

B. Method A: Lime Slurry – One part lime and three parts water by weight.
   1. Add lime at a minimum of 1 percent by weight.
   2. Maintain the lime slurry mix in a malted milk consistency.
   3. Deliver lime slurry to the twin shaft pugmill for mixing with aggregate.
   4. Adjust quantity (percent) of lime as necessary, based on results of Hamburg Wheel Tracker test.

C. Method B: Lime and Aggregate Stockpile Marination:
   1. Provide sufficient free moisture to thoroughly wet the aggregate and activate the lime before introducing hydrated lime.
   2. Add lime at a minimum of 1 ½ percent by weight.
   3. Thoroughly mix wet aggregate/lime mixture in a twin shaft pugmill.
   4. Marinate the aggregate/lime mixture in the stockpile for a minimum of 48 hours.
   5. Adjust quantity (percent) of lime as necessary, based on results of Hamburg Wheel Tracker test.
   6. Use the wet cured aggregate within 60 days.

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 CONTROL AND MONITOR

A. Control the lime batching operation by the Program Logic Control (PLC) System based upon production set up data.

B. Monitor the following aspects and record on the computer data log printout:
   1. Display target and actual rates.
   2. Belt weight bridge for lime.
   3. Locked-in water meter.
   4. Meter to transfer lime slurry.
   5. Closed end loop to mainframe computer.

3.3 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:
   1. Prime coat: Liquid or emulsified asphalt to a prepared subgrade or untreated base course.
   2. Tack coat: Cutback or emulsified asphalt to the existing surface or new pavement surface and intermediate lifts.

B. Blotter materials and procedures for absorbing excess asphalt as required.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 02745: Asphalt Material

1.3 REFERENCES

A. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

B. AASHTO T 201: Kinematic Viscosity of Asphalts

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 PRIME COAT

A. MC-70 or MC-250, meeting the requirements of Section 02745.

B. Blotter material: Granular materials following AASHTO T 27, meeting the following criteria:

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. CSS-1h emulsified asphalt meeting the requirements of Section 02745.
   1. Diluted 2:1 – two parts concentrate to one part water by the manufacturer.
      a) Dilute at terminal only.
      b) Do not change dilution without obtaining prior written approval from the Engineer.

B. Tack coat referred to 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 following Section 02056.

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, etc.
   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/yd^2
   2. Tack Coat: 0.15 gal/yd^2

   The above application rates may vary according to field conditions. Obtain approval for the quantities, rate of application, temperatures, and areas to be treated before any application.

B. Do not apply prime coat or tack coat:
   1. On a wet surface.
   2. When the surface temperature is below 50 degrees F.
   3. When weather conditions prevent it from adhering properly.

C. Protect all structures including guardrails, guide posts, etc. 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. AASHTO T 201.

F. Immediately apply another application to under primed surface.

G. Apply a prime or tack coat to all surfaces, including vertical that will come in contact with Hot Mix Asphalt.

H. Spread blotter material if the prime coat fails to penetrate. Use the quantities required to absorb the excess asphalt.

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; clean, maintain, and prepare joints; 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. ASTM D 3405: Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer's product data, specifications, 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 SEALING COMPOUND

A. Refer to Section 03390.

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. 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 pound class or smaller hand jackhammers.

C. The Department's representative will remark the area that is discovered to be spalled or delaminated during the initial removal of the damaged portion. 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 at the Contractor's expense.

3.2 CLEAN ALL EXPOSED SURFACES

A. Remove all loose particles, oil, dust, traces of asphalt concrete, or other contaminants. Use sandblasting or waterblasting at a minimum 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, fiberboard, etc. before placing the mix. 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. 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. Apply with a brush to bottom and sides of repair area.
      b. Use an appropriate material meeting AASHTO M 235 when using epoxy bonding agent. Select Type and Class for the application. 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 the following 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 ⅛ inch of the existing pavement.

3.6 CURE AND PROTECT

A. Cure the patched surface immediately after finishing operations with the material meeting Section 03390 with the following change:
   1. Uniformly spray the surface at a rate of 50 ft^2/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 to the Engineer's satisfaction, at no expense to the Department, 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. 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 ASTM D 3405.

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. Materials and procedures for constructing Portland Cement Concrete Pavement.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 01452: Pavement Smoothness

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 157: Ready-Mixed Concrete

B. AASHTO M 324: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

C. AASHTO T 22: Compressive Strength of Cylindrical Concrete Specimens

D. AASHTO T 23: Making and Curing Concrete Test Specimens in the Field

E. AASHTO T 24: Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

F. AASHTO T 325: Estimating the Strength of Concrete in Transportation Construction by Maturity Tests

G. American Concrete Institute (ACI) Standards

H. Department of Labor Standards

I. UDOT Minimum Sampling and Testing Requirements

J. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. All submittals required in Section 03055.
   1. Mix design trial batch information to include flexural test results.

B. Certified scale axle weights for each haul unit in terms of yardage to be hauled when requested by the Engineer.

C. Portland cement concrete pavement texturing plan.

D. A written plan for approval 14 calendar days before concrete placement showing proper attention will be given to:
   1. Ingredients
   2. Production methods
   3. Handling and placing
   4. Sampling, testing, and storage including details for platform or optional on-grade facilities
   5. Protection and curing including hot or cold weather plan or both

E. Verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material according to UDOT Minimum Sampling and Testing Requirements.

B. Department will assess price adjustments for strength, thickness, and surface smoothness separately on the contract bid price**.**

C. Thickness
   1. Contractor obtains cores for thickness. Refer to AASHTO T 24.
      a. Engineer marks core location.
      b. One thickness core per 12,000 $ft^{2.}$

   2. Determine 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 ⅛	1.00
⅛ to ¼	0.90
¼ to ½	0.75
½ to ¾	0.60
>¾	Reject

a. The Engineer may accept pavement deficient by more than ¾ inch at 50 percent pay or require removal and replacement.

b. Make all corrections, including removal and replacement, at no additional cost to the Department.

c. Contractor takes two additional cores for any deficient core (one on each side) where the thickness varies by ⅛ inch. Locate the new core midway between the deficient core and each of the adjacent cores.

d. 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.

D. Compressive Strength Acceptance Retesting

1. Department will use Table 2 to determine pay adjustments for concrete compressive strength.

a. The pay adjustment applies to the test lot represented by the strength test.

b. The Engineer evaluates all concrete with a compressive strength of more than 400 PSI below specification to determine structural integrity of the concrete pavement. This pavement may be accepted at 50 percent pay factor or removed and replaced at the discretion of the Engineer.

Table 2

Pay Adjustments for Compressive Strength Based on 28 days	
psi below f'_c (4,000)*	**Pay Factor**
1 to 100	0.95
101 to 200	0.90
201 to 300	0.85
301 to 400	0.80

* From Section 03055 Table 4

2. Hand-placement areas will be considered separately.
3. Retesting - The Engineer notifies the Contractor, within three calendar days of determining the 28-day compressive strength, if any test is below specifications. The Contractor may request referee testing in writing.
4. An independent third party testing agency will conduct referee testing at no additional cost to the Department.
5. Retesting must be completed within 40 days after placement.
6. Testing laboratories must:
   a. Be a UDOT qualified lab in concrete.
   b. Use UDOT TTQP personnel qualified in Concrete Testing Technician and Concrete Strength Testing Technician.
   c. Obtain two sets of three cores at locations directed by the Engineer.
   d. Obtain and test cores according to AASHTO T 22 and AASHTO T 24.
   e. Calculate the average of each set of three cores.
   f. Fill the core holes with concrete after coring
   g. Make sure that the holes are cleaned with no standing water before they are filled.
   h. Consolidate the concrete by rodding or vibrating.
   i. Strike off level with the pavement surface and texture.
   j. Protect concrete in core holes from any damage for a minimum of 48 hrs.
   k. Basis of acceptance of the lot will be as follows:
      1) The Department accepts the lot at full pay if the average strength of both sets of three cores is greater than or equal to 85 percent of f'_c, and if no single strength test is less than 75 percent of f'_c.
      2) The Department uses the original cylinder compressive strengths for the pay factor if the above criteria are not met.

E. Smoothness
   1. Evaluate and refer to Section 01452.

F. Quantity adjustment when paving over existing surfaces.
   1. Adjust quantity when accepted batched volume overruns or underruns neat-line volume.
      a. Engineer and Contactor determines accepted batched volume at time of placement.
      b. Accepted batched volume is the total batched material adjusted to design yield minus rejected or wasted material.
   2. Adjust quantity prior to 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	=	Accepted Volume
V_n	=	Neat-line Volume
Q_m	=	Measured quantity in yd^2

PART 2 PRODUCTS

2.1 CONCRETE

A. Use AA(AE) concrete. Refer to Section 03055.
   1. Meet a 28-day flexural strength of 650 psi verified through trial batch.

2.2 CONCRETE CURING COMPOUND

A. Refer to Section 03390.

2.3 EXPANSION JOINT MATERIALS

A. Refer to Section 03152.

2.4 JOINT SEALERS

A. Use hot applied joint sealant for all joints meeting Section 03152.

2.5 STEEL REINFORCEMENT

A. Tie Bar: Grade 60 or higher, deformed reinforcing steel. Refer to Section 03211.

B. Dowel Bars: Grade 60 or higher, smooth steel rod. Refer to Section 03211.

C. Chairs and Basket assemblies. Refer to Section 03211.

2.6 BATCH PLANT

A. Meet the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

2.7 TESTING PLATFORM

A. Provide a stable, 40 ft by 8 ft testing platform with a canopy when concrete is hauled in dump trucks.
   1. Provide a lockable 8 ft by 10 ft by 8 ft storage room at one end.
   2. Locate the platform within 250 ft of the batch plant.
   3. Platform height must equal the concrete haul truck bed height.
   4. Platform must meet the Department of Labor standards outlined in Safety and Health Regulations for Construction.
   5. Provide adequate railing and stairs with a handrail.
   6. Provide 110 V electrical power and pressurized water.
   7. Maintain suitable lighting and electrical outlets and a communication system with the batch plant control room.
   8. Furnish internal vibrators and storage devices for making and curing the test specimens. Refer to AASHTO T 23.

2.8 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 7-day temperature recorder, accurate within 2 degrees and having a permanent recording feature.

B. Use device or devices with the capacity to accommodate the required test cylinders for a minimum of 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.

D. Submit written procedures explaining operation and required monitoring or care of the device for approval at the request of the Engineer.

E. A 24-hour test run may be required.

2.9 VEHICLES FOR HAULING

A. Permissible to use:
   1. End dump trucks with watertight beds and end gates and rounded corners.
   2. Agitator trucks with open tops.
   3. Transit mixers that conform to AASHTO M 157.

B. Do not use bottom or belly dump units.

2.10 SLIP FORM PAVER

A. Self-propelled machine with no fluid leaks equipped with automatic line and grade control capability.

B. Capable of:
   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. Do not interfere with dowel basket assemblies if redistributing the concrete in front of the paver.

D. Vibrator minimum requirements:
   1. Eccentric Diameter: 1⅞ inch
   2. Frequency: 7,000 to 9,000 vibrations per minute
   3. Spacing: 18 inch maximum, mounted longitudinally

E. Mount vibrators to insure adequate concrete consolidation. Do not interfere with dowel bar basket assemblies.

F. Run the vibrators parallel to the direction of the paving.

G. Monitor the operation of vibrators
   1. Check each vibrator at the beginning and ending of each day.
   2. Repair or replace vibrators as necessary.
   3. Stop paving operations immediately if any indication of malfunction occurs.
   4. Resume operations only after repairing or replacing the vibrator.

H. Use trailing forms long enough to leave a smooth, straight, vertical edge.

I. Stop vibrating and tamping elements when the forward movement of the paver stops.

2.11 FINISHING/TEXTURING EQUIPMENT

A. Machine float that may be attached to the paver.

B. Burlap drag unless using artificial-turf drag.

C. Texturing equipment as approved by the Engineer.

D. 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 ⅛ inch and deviations in the vertical edge of the pavement to ¼ 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.
   3. Control systems:
      a. Must be automatically actuated from an independent line and grade control reference using a system of mechanical sensors or sensor-directed devices.
      b. Use sensors that maintain the equipment at the proper transverse slope and elevation to obtain the required thickness and surface.
      c. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for the placing machine, etc.

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.
4. Provide vibrators to thoroughly consolidate concrete.
   a. Position vibrators on finishing equipment ahead of strike-off auger or final screed.
   b. Use hand-operated vibrators on a regular pattern not to exceed 12 inches in each direction for hand placements.
5. Immediately apply curing compound to the edges of the pavement after form removal.

D. Fill honeycomb areas in the vertical edge of the pavement with mortar.

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 1½ inch to No. 4 sieve with the separation being made on the 1 inch and ¾ 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. Maintain a mixing time of 80 seconds at manufacturer recommended mixing speed after all materials are in the drum. Increase mixing time in 10-second increments until the mixer efficiency evaluation is passed if necessary.
3. Correct poor mixing efficiency at no additional cost to the Department.
4. Do not allow buildup of cement or mortar on the mixer drums and blades.
5. Mix for a minimum of 30 seconds after the last addition of water or cement is made after initial batching.

D. 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 with a lay down machine within the time frame listed below after introducing the mixing water to the cement and aggregates. Reject concrete not placed within the following time period.
   1. Non-agitating Haul Equipment: 45 minutes
   2. Agitating Haul Equipment: 75 minutes

C. Deposit the concrete so rehandling is not required.

D. Vibrate, screed, and mechanically tamp the spread concrete. Thoroughly vibrate adjacent to and along the faces of the forms.

E. Workmanship conforms to ACI 304R-00.

F. Do not add water to the pavement surface behind the final screed on the paver.

G. Do not add water to the surface for finishing.
   1. Paving operations may be shut down and the concrete rejected if water is added.

H. Concrete may be placed in an adjoining longitudinal section (companion placement) when 2,500 psi has been achieved and verified by either:
   1. Maturity Method: Refer to AASHTO T 325
   2. Cast cylinders

I. Provide protection for initial surface.

J. Repair any damage to existing pavement resulting from companion placement at no expense to the Department.

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 as shown on the plans.
   1. Refer to PV Series Standard Drawings.
   2. Place normal to direction of paving and parallel to the slab surface.
   3. Place by using automatic bar inserters, support on chairs, through forms, or drilled and epoxied. Manual insertion is not permitted.

C. Place bars in the middle third of the slab depth, parallel to the centerline and surface of the slab when load transfer dowel bars are required. Limit deviations from parallel to ¼ inch in 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. 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. Texture the pavement by burlap 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. Provide in writing to the Engineer prior to placing pavement a texturing plan showing texturing locations and describing methods that will be used for hand texturing. Refer to Table 3.

Table 3

Pavement Texturing Options	
> 50 mph	≤ 50 mph
Longitudinal Tining	Longitudinal Tining
Diamond Grinding	Diamond Grinding
Transverse Tining	Transverse Tining
	Artificial Turf Drag

B. Demonstrate the performance of the texturing application method prior to commencement of main line paving.

C. Longitudinal Tining:
   1. Produce grooves of approximately ⅛ inch by ⅛ inch (W x D) spaced ¾ inch apart and parallel to the longitudinal joint.
   2. Keep tining devices clean and free from encrusted mortar and debris to ensure uniform groove dimensions.
   3. Time tining finishing so that the grooves do not close up.

D. Diamond Grinding:
   1. Produce resultant surface in a parallel, corrugated type texture.
      a. Allowable width of grooves is $^{1}/_{16}$ inch to ¼ inch.
      b. Allowable distance between grooves is $^{1}/_{16}$ inch to ¼ inch.

c. Maximum allowable height of ridges is approximately $^{1}/_{16}$ inch.

2. Maintain cross slope drainage.

E. Transverse Tining: Produce randomly spaced ½ inch to ¾ inch transverse grooves approximately ⅛ inch deep.

F. 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 $^{1}/_{16}$ inch to ⅛ inch deep.
3. Use turf with a blade density of 7,200 blades/sq ft and each blade at least ¾ 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.

3.7 CURE

A. Refer to Section 03390.

3.8 PROTECTION

A. Protect pavement against all damage and marring.
1. Do not allow traffic on the pavement.
2. Construct crossings to bridge the concrete as approved by the Engineer when necessary at no additional cost to the Department.

B. Do not allow Contractor hauling equipment or traffic on the pavement until 100 percent of the design strength has been achieved. Verify strength by either:
1. Maturity method: Refer to AASHTO T 325
2. Cast cylinders

C. Submit a written plan to the Engineer for approval 14 calendar days before concrete placement showing proper attention will be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures and water evaporation that can impair concrete strength, integrity, or serviceability. Refer to ACI 305R-99.

3.9 JOINTS

A. Construct contact joints, sawed joints, or transverse expansion joints as shown on the plans.

B. Keep the faces of all joints at right angles to the top surface of the pavement with all 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 ¼ 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 ¼ 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.
   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 joints of all loose debris, cement powder, etc.
   6. Clean and dry joints before placing sealant.
      a. Clean the joint with air at a minimum of 100 psi.
      b. Equip air compressors with operating oil and water traps.

7. Use hot-pour joint sealant unless specified otherwise. Refer to AASHTO M 324.
8. Fill the longitudinal joints flush. Refer to PV Series Standard Drawings.
9. Do not permit hauling equipment or traffic on the pavement before all sawed joints are sealed.
10. Match joints in adjacent lanes to form a continuous line across the pavement width including the concrete shoulders.

F. Form joints at structure approaches by using a joint filler strip and joint sealer when transverse expansion joints are shown on plans and sleeper slabs are not used.

3.10 DEFECTIVE PAVEMENT PANELS

A. A panel is that area of pavement within the traffic lane bound by two transverse joints.

B. Engineer determines defective panels within 21 calendar days after placement.

C. Repair or replace defective pavement panels at no additional cost to the Department.
   1. Complete repairs before acceptance testing for smoothness.

D. Remove and replace panels when multiple full depth cracks separate the panel into three or more pieces.

E. Use methods that do not disturb or damage adjacent panels.

F. Remove and replace portions of panels within the traffic lane and the adjacent shoulder with any full depth transverse crack within 4 ft or less of a transverse sawed joint.

G. Drill and epoxy tie-bars/dowel bars as required into existing pavement.

H. Match the profile and texture of existing pavement.

I. Repair any crack connecting joints appearing within 21 calendar days after placement.
   1. Rout to a 1 inch depth by ⅛ inch width and seal with silicone sealant.

J. Leave tight random cracks less than $^{1}/_{64}$ inch wide undisturbed.

3.11 LIMITATIONS – GENERAL

A. Adhere to limitations of Section 03055 except as modified below.

B. Night Operations: Provide proper lighting from one-half hour after sunset to one-half hour before sunrise following Section 00555.

C. Precipitation
   1. Cease operation when rain is threatening.
   2. Remove, replace, or repair any pavement damaged by rain or hail as directed at no additional cost to the Department.

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. Adhere to approved contractor pavement protection plan this Section, article 3.8

3.12 LIMITATIONS – COLD WEATHER

A. Cold weather limitations apply when the temperature is forecast to fall below 40 degrees F within 14 days of placement.

B. Comply with the following regulations 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 (cover, insulation, heat, etc.)
   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 until a compressive strength of at least 3,500 psi has been achieved, determined by either:
      a. Maturity method: Refer to 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. Determine the concrete temperature with a surface thermometer insulated from surrounding air.

9. Paving may begin when base surface temperature is 36 degrees F in the shade and ascending.
10. Cease operations when the ambient temperature is 45 degrees F in the shade and decreasing.
11. Remove and replace concrete damaged by frost action at no additional cost to the Department.
12. Do not use material containing frost or lumps.

C. Heating Aggregate and Water
1. Provide and operate heating devices at no additional cost to the Department 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.

3.13 LIMITATIONS – HOT WEATHER

A. 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

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer's product data, specifications, and recommended installation instructions.

PART 2 PRODUCTS

2.1 FULL DEPTH CONCRETE PAVEMENT REPAIR MATERIAL

A. Follow Section 02752, except:
   1. It is acceptable to use high range water reducers such as Super Plasticizers.

2. It is acceptable to accelerate the rate of concrete strength gain to match the field placement schedule with written permission from the Engineer.

B. Use an Epoxy Resin Adhesive meeting AASHTO M 235. Select Type and Class for the application.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove panel, panels, or panel section.
   1. Determine the extent and dimensions of the repair from the plan sheets, or as directed by the Engineer. Adhere to the requirements of PV series Standard Drawings.
   2. Complete the removal and make full depth cuts around the perimeter of the rectangular section to be removed. Minimize saw overcuts.
   3. Remove panels by lift-out method. 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. Form to match existing panels, providing a vertical edge.

D. Place dowel and tie bars.
   1. Place bars in locations as per PV series Standard Drawings. Use tie-bars or smooth dowels where indicated on standard drawings.
   2. Stockpile bars in an area where they are kept clean and free from damage.
   3. Drill holes mid-depth of the slab without causing damage to the remaining pavement section such that bar placement tolerances can be met.
   4. Drill multiple holes simultaneously with drills held horizontally in a rigid frame. 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 ¼ inch movement, on protruding dowels used at expansion joints. Submit a sample of the end caps to the Engineer for approval before use on the project.
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. Perform sawing in accordance with Section 03390.

3.2 PLACE CONCRETE

A. Place concrete in compliance with Section 02752.

B. Consolidate the mix in compliance with Section 02752.

C. Weather Limitations: Refer to Section 03055.

3.3 FINISH CONCRETE

A. Finish patch to ± ⅛ inch of existing profile.
1. Correct patch profiles in excess of ⅛ inch higher than the existing pavement profile through surface grinding or removal and replacement.
2. Correct patch profiles in excess of ⅛ inch lower than the existing pavement profile through removal and replacement of the patch.
3. Pay for any corrections to the finish of the patch.

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.

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. Pay for removing and replacing any defective panels. Refer to Section 02752.

G. Protect the individual placements with approved barricades.

3.5 LIMITATIONS

A. Refer to Section 03055.

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 M 148: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

B. AASHTO T 22: Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens

C. ASTM C 882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Provide the Engineer with documentation from the manufacturer verifying that the patching material meets the requirements of this Section, article 2.1 paragraph F.

PART 2 PRODUCTS

2.1 MATERIALS

A. Dowel Bars: 1½ inch x 18 inch, smooth steel rod, following Section 03211.

B. Bond Breaking Compound: Use a bond-breaking compound approved by the Engineer.

C. Chair Devices: Coat according to Section 03211, or make of non-metallic materials, the devices used to support and hold the dowel bar in place.
   1. Provide a minimum clearance of ½ inch between the bottom of the bar and the surface upon which the chair is placed.

D. End Caps:
   1. Place on dowels, tight fitting end caps made of non-metallic materials that allows for ¼ inch movement of the bar at each end.
   2. Submit a sample of the end caps to the Engineer for approval prior to use on the project.

E. Caulking Filler: Submit a sample of the caulking filler to the Engineer for approval prior to use on the project.

F. Patching Material:
   1. Use mix with ¼ inch nominal maximum aggregate size.
   2. Select a material that meets the following performance criteria:
      a. Material must achieve a minimum compressive strength of 4,000 psi at 28 days according to AASHTO T 22.
      b. Material must achieve a minimum bond strength of 1,000 psi at 24 hours according to ASTM C 882.

G. Joint/Crack Preservation Material: Use a rigid removable material capable of maintaining the joint or crack.

2.2 EQUIPMENT

A. Jackhammers: Use jackhammer less than the nominal 30 lb class to prevent spalling.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Saw cut the pavement as required per PV Series Standard Drawings.

B. Jackhammer and sand blast to clean all exposed surfaces and cracks, removing slurry and loose concrete.

C. Clean up and properly dispose of all residues from the saw, jackhammer and sand blasting process.

D. Place caulking filler in existing joint or crack to prevent intrusion of patching material. See PV Series Standard Drawings.

E. Pre-coat the dowel bars with a bond-breaking compound.

F. Place the foam core board on the dowel bar in line with the transverse joint or crack.

G. Fit the foam core board tightly around the dowel bar and to the bottom and edges of the slot.

H. Maintain the foam core board in a vertical position and tight to all edges during placement of the patching material as per PV Series Standard Drawings.

I. Place bars so that the bars do not extend more than 11 inches past the centerline of the slot.

J. Provide a minimum space of ½ inch in all directions around bar.

K. Repair or replace any dowel bars damaged at no cost to the Department.

L. Dampen thoroughly all surfaces of the slot immediately prior to filling with patching material.
   1. Prevent standing water in the slot.
   2. Remove all excess water with compressed air.

M. Fill the slot with an approved patching material.
   1. Consolidate the material in the slot and around the dowel bar with an appropriate size vibrator.
   2. Finish patching materials to existing surfaces.
   3. Place and cure the patching material according to manufacturer's specifications.
   4. Require a representative from the manufacturer of the patching material to be on-site for the first day's placement.
   5. Cure using ASHTO M 148, Type 1-D, Class A.

N. Replace any individual dowel bar retrofit not functioning or damaged at no cost to the Department.

O. Remove joint preservation material as needed and repair per to a depth of 2 inches and reseal.

P. Obtain cores through the slot and dowel system to verify placement of the dowel bar and consolidation of the material around the dowel bar.
   1. Obtain three cores from random locations from each of the first three production days.
   2. Use cores from subsequent production days at the discretion of the Engineer.

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 an acceptable grade for a suitable ride.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM C 618: Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

B. ASTM C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

C. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics

E. ASTM D 1622: Apparent Density of Rigid Cellular Plastics

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 QUALITY ASSURANCE

A. Obtain approval from the Engineer for injection material properties prior to placement.

B. Provide to the Engineer copies of invoices from mix suppliers.

1.7 WARRANTY

A. Supplier warrants all materials and workmanship for a period of one year against shrinkage or deterioration.

B. Supplier replaces by re-injection or slab replacement any material that fails during the warranty period.

1.8 PAYMENT PROCEDURES

A. Accepted liquid quantities measured using a calibrated meter paid for at the contract unit price per cubic meter.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYURETHANE

A. Use water based formulation of expanding high-density polyurethane for raising slabs that set to full compressive strength within 15 minutes after injection.

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. 100 psi
Elongation	N/A	Max. 5.1%
Compressive Strength at Yield Point	D 1621	Min. 90 psi

*Use the value of flexural strength or flexural yield as tensile strength.

2.2 PORTLAND CEMENT DRY MIX DESIGN

A. Use standard mix design for jacking and grouting slabs with voids less than 30 inches as follows:
   1. One part (by volume) portland cement type I or II, refer to ASTM C 1107.
   2. Three parts (by volume) pozzolan (natural or artificial), refer to ASTM C 618 Type F.

B. Use optional mix design for jacking and grouting slabs with voids greater than 30 inches as follows:
   1. One part (by volume) portland cement type I or II, refer to ASTM C 1107.
   2. One part (by volume) pozzolan (natural or artificial), refer to ASTM C 618 Type F.
   3. Two parts (by volume) clean sand.

C. Obtain Engineer's approval for any deviation from dry mix proportions of mix design including addition of liquefier or water reducing agents.

D. Adjust water content to meet local conditions.

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 ⅛ 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.

3.2 INSTALLATION

A. Drill holes as determined 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 ± ⅛ inch of finished grade profile.

END OF SECTION

SECTION 02761

LONGITUDINAL RUMBLE STRIP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing longitudinal rumble strip on the final roadway surface.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS

A. HMAP - Hot Mix Asphalt Pavement

B. PCCP - Portland Cement Concrete Pavement

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 EQUIPMENT – HMAP/PCCP GRINDER

A. Construct longitudinal rumble strip with equipment using a rotary type cutting head, capable of obtaining the required groove width in a single pass while moving in the same direction as the flow of traffic.
   1. Use equipment with cutting heads having 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 $^{1}/_{16}$ inch between peaks or valleys.

B. Apply asphalt flush coat at a uniform rate of 0.10 gal/yd^2 diluted two parts concentrate to one part water by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construct longitudinal rumble strip to the dimensions and spacing as shown on PV Series Standard Drawings.
   1. Establish lane widths of 12 ft prior to the installation of longitudinal rumble strip.
   2. Construct longitudinal rumble strip prior to the placement of Chip Seal Coat, if required.

B. Provide a positive means of controlling the alignment.
   1. Alignment pattern edge will be randomly verified by the Engineer.

C. Construct a 500 ft long test section 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. Repair or replace pavement as determined by the Engineer if the test section is unacceptable.

D. Remove resulting debris prior to opening the adjacent lane to traffic.
   1. Dispose of material according to Federal, State, and Local regulations and in a manner acceptable to the Engineer.

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 as edge lines, center lines, broken lines, guidelines, contrast lines, symbols, and other related markings.

C. Remove pavement markings.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 247: Standard Specification for Glass Beads Used in Traffic Paints

B. ASTM D 562: Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

C. ASTM D 2205: Standard Guide for Selection of Tests for Traffic Paints

D. ASTM D 2743: Standard Practices for Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography

E. ASTM D 2805: Standard Test Method for Hiding Power of Paints by Reflectometry

F. ASTM D 3723: Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing

G. ASTM D 3960: Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

H. ASTM D 4451: Standard Test Method for Pigment Content of Paints by Low-Temperature Ashing

I. ASTM D 5381: Standard Guide for X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders

J. ASTM E 1347: Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry

K. Federal Standards

L. Manual on Uniform Traffic Control Devices (MUTCD)

M. UDOT Materials Manual of Instruction, Part 8

N. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. Provide documentation of the manufacturer and production batch identification for the paint used.

B. Provide fixtures such as ball valves, gate valves, or others on paint truck for the purposes of obtaining field samples.

C. Agitate the paint to allow for thorough mixing. Follow paint manufacturer's recommendation for agitation and mixing times.

D. Stop all agitation before sample is drawn.

E. Calibrate all meters on the paint truck annually and certify for application rate verification.
   1. Use the following calibration tolerances for meters:
      a. Paint: ± 0.1 gal
      b. Beads: ± 0.5 lb/gal
   2. Keep a clean, legible copy of calibration report with the paint truck.
   3. Provide a copy of certification at the Engineer's request.

F. The Engineer will:
   1. Visually inspect lines, legends, symbols, and messages to verify compliance with the required dimensions.
   2. Inspect at a minimum at the end of each production day.

3. Verify quantities applied by either of the following methods:
   a. Measuring both paint and bead tanks prior to and after application.
   b. Witnessing the meter readings prior to and after application.
      1) A printout of meter readings, in lieu of witnessing, may be accepted at the Engineer's discretion.
4. Sample in accordance with the UDOT Materials Manual of Instruction, Part 8-932 and the UDOT Minimum Sampling and Testing Requirements.

G. Repaint any line or legend failing to meet bead adherence and dimensional requirements.

H. Price Reductions. When more than one of the requirements of the pavement markings is deficient, the result with the highest price reduction governs.
   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
At the specified mil thickness	1.00
1-10 percent below the Specified wet mil thickness	0.75
11-15 percent below the Specified wet mil thickness	0.50
More than 15 percent below the Specified wet mil thickness	0.00 *

* Repaint pavement markings at no cost to UDOT.

   2. Price reductions for pavement markings installed below the specified total solids, pigment, and non-volatile vehicle content (shown in table 4) are outlined in Table 2.

Table 2

Price Reduction for Total Solids, Pigment and Non-Volatile Vehicle	
	Pay Factor
At or above the specified percentage	1.00
Up to 0.5 percent below the specified percentage	0.85
0.5 to 1.0 percent below the specified percentage	0.70
More than1.0 percent below the specified percentage	0.00 *

* Repaint pavement markings at no cost to UDOT.

3. Price reductions for pavement markings that fail to meet the remaining requirements of Table 4 are outlined in Table 3.

Table 3

Price Reductions	
	Pay Factor
At the specified requirements	1.00
Up to1 percent deficient	0.90
1 to 2 percent deficient	0.80
2 to 3 percent deficient	0.70
3 to 4 percent deficient	0.60
4 to 5 percent deficient	0.50
More than 5 percent below specified quantitative requirements	0.00 *

* Repaint pavement markings at no cost to UDOT.

PART 2 PRODUCTS

2.1 PAINT

A. Meet the requirements for Acrylic Water Based Paint as listed in Table 4:

Table 4

Paint Requirements				
Property	White	Yellow	Black	Test
Pigment: Percent by weight	63.0	63.0	63.0	ASTM D 3723
Total Solids: Percent by weight, minimum	79.0	79.0	79.0	ASTM D 2205
Nonvolatile vehicle: Percent by weight vehicle, minimum*	43.0	43.0	43.0	ASTM D 2205
Viscosity, KU @ 77 degrees F	80 - 95	80 - 95	80 - 95	ASTM D 562
Density, lb/gal	14.1 ± 0.3	14.1 ± 0.3	14.1 ± 0.3	ASTM D 2205
Volatile Organic Content (VOC): lb/gal, maximum	1.25	1.25	1.25	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 UDOT. 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, ASTM D 4451 and ASTM D 5381: Tests used to verify paint samples meet ASTM requirements.

2.2 GLASS SPHERES (BEADS) USED IN PAVEMENT MARKING PAINT

A. Specific Properties: Meet AASHTO M 247 with the following exceptions.
   1. Gradation:

Passing a No. 14 sieve, percent	95 - 100
Passing a No. 16 sieve, percent	80 - 95
Passing a No. 18 sieve, percent	10 - 40
Passing a No. 20 sieve, percent	0 - 5
Passing a No. 25 sieve, percent	0 - 2

   2. Beads: Silane adhesion coating.
   3. Roundness - The glass beads will have a minimum of 80 percent true spheres.

B. 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 at no expense to the Department. 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 and other foreign material and follow manufacturer's recommendations for surface preparation.

3.2 APPLICATION

A. Apply Pavement marking paint at the following wet mil thickness requirements.

1. 20 – 25 wet mils for all longitudinal markings.

Example Calculation: (Verify wet mil thickness)

$$\text{Wet Mils} = \frac{(0.133681\ ft^3/gal) * 12000\ mil/ft}{(X\ ft/gal)(Z\ ft)}$$

Where
X = application rate. (Meter readings or dipping tanks).
Z = line width measured in feet.
12000 = conversion from ft to mil
0.133681 = conversion from gallons to cubic feet.

For information only: 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

2. 23 – 40 wet mils for all painted legends as determined by a wet mil gauge.

B. Refer to Table 1 for pavement markings that are less than required wet mils in thickness.

C. No additional payment for pavement markings placed in excess of required wet mils in thickness or exceeding dimensional requirements outlined in this Section, article 3.1 paragraph A.

D. Glass Sphere (Beads): Apply a minimum of 8 lb/gal of paint, the full length and width of line and pavement markings.

1. Do not apply glass beads to contrast lines (black paint).

E. Begin striping operations no later than 24 hours after ordered by the Engineer.

F. At time of application apply lines and pavement markings only when the air and pavement temperature are:
   1. 50 degrees F and rising for Acrylic Water Based Paint.

G. Comply with TC Series Standard Drawings.

3.3 CONTRACTOR QUALITY CONTROL

A. Application Rate: Verify that the paint and beads are being applied within specified tolerances prior to striping.

B. Curing: Protect the markings until dry or cured. In the event that the uncured marking is damaged the marking will be reapplied and track marks left on the pavement will be removed at no additional cost to the Department.

3.4 REMOVE PAVEMENT MARKINGS

A. Use one of these removal methods:
   1. High pressure water spray,
   2. Sand blasting,
   3. Shot blasting,
   4. Grinding.

   Grinding is not allowed on the final surfacing unless the Engineer grants prior written approval.

B. Do not eliminate or obscure existing striping, in lieu of removal, by covering with black paint or any other covering.
   1. The Engineer may grant prior written approval for use of black paint or other obscuring material for work durations shorter than “long term stationary” as defined in the Temporary Traffic Control section of the MUTCD.

C. Use equipment specifically designed for removal of pavement marking material.

END OF SECTION

SECTION 02768

PAVEMENT MARKING MATERIALS

(Warranty Specification)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Methods and materials for installing pavement marking materials including Pavement Marking Tape, Solvent-Free and Lead-Free Epoxy, Methyl-Methacrylate, and Thermoplastic legends.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Manufacturer Warranty:
   1. Provide a full warranty covering 100 percent of the pavement marking materials.
      a. Manufacturer is responsible for quality control of the materials, proper placement by the Contractor or subcontractor, and all other factors that affect the service life of the materials.
      b. Remove or replace 100 percent of the markings for all failed sections at no cost to Department in the event of a performance failure.
      c. Failed sections are defined in this Section, Part 2 for each pavement marking material.

B. Warranty Bond:
   1. The manufacturer provides a warranty bond for the total bid price of the material. The total bid price will be calculated by using the quantity of pavement marking material listed in the engineers estimate and the average unit bid price for said material obtained from the Construction Division's Project Development Business System (PDBS).
   2. Warranty period covers the specified service life of the materials, and begins after all pavement markings are installed and accepted.
   3. Submit proof of bond to the Engineer before placing the material.

C. Traffic Control: Refer to Section 01554.

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's recommendations.

B. Provide Material Safety Data Sheets (MSDS) upon delivery of material.

1.7 MANUFACTURER SERVICE REQUIREMENT

A. Provide technical support to the Contractor during the placement of the marking materials, including information about handling, storage, placement, and other training that may preserve the quality of the installed markings.

1.8 SERVICE LIFE TESTING

A. Department performs service life testing.

B. Performance measures: Retro-reflectivity, color contrast and stability, and durability under all traffic volumes and wear conditions, unless stated otherwise.

C. Retro-reflectivity is measured using a Federal approved instrument (30 m geometry).

D. Take readings on clean surface areas free of debris when performing Service Life Testing.

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:
   1. Longitudinal lines: 48 months.
   2. Legends and symbols: 18 months.

D. Performance Measures for Retro-reflectivity, Color Contrast/stability, and Durability.
   1. Minimum Retro-reflectivity:
      a. White longitudinal lines: 125 millicandelas.
      b. Yellow longitudinal lines: 125 millicandelas.
      c. Legends and symbols: 125 millicandelas.
   2. Minimum Color Contrast and Stability: For white markings, provide a minimum yellowness index of 30 when measured with a portable colorimeter (XYZ C/2).
   3. Minimum Durability Level: 90 percent of the longitudinal line on any 1,000 ft segment or 90 percent of the legend and symbol must be present.
   4. 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. Replace under the warranty terms.

2.2 SOLVENT-FREE 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, Color Contrast/stability, and Durability.
   1. Minimum Retro-reflectivity:
      a. White longitudinal lines: 125 millicandelas.
      b. Yellow longitudinal lines: 125 millicandelas.
      c. Legends and symbols: 125 millicandelas.
   2. Minimum color stability: Yellowness Index of White Paint on concrete or asphalt surfaces: 30 or less.
   3. Minimum Durability Level: 90 percent of the longitudinal line on any 1,000 ft segment or 90 percent of the legend and symbol must be present.

4. 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. Replace under the warranty terms.

D. Retain a one pint sample from each lot or batch used.
   1. 24 months for Type I
   2. 48 months for Type II.

E. Repaint pavement markings that are below 16 wet mils in thickness.
   1. No payment for materials placed in excess of 20 wet mils in thickness.

F. Use beads according to manufacturer's recommendations.

2.3 METHYL METHACRYLATE

A. Use a two-component pavement marking system compliant with Federal VOC regulations used for longitudinal lines, legends and symbols and for use on all pavement surfaces.

B. Profiled, non-profiled, inlaid, inverted profile with bump, inverted profile without bump, and spray.

C. 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.

D. Performance Measures for Retro-reflectivity and Durability.
   1. Minimum retro-reflectivity:
      a. White Longitudinal markings: 125 millicandelas.
      b. Yellow Longitudinal markings: 125 millicandelas.
      c. Legends and Symbols: 125 millicandelas.
   2. Minimum Durability 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. Replace under the warranty terms.

E. Remove and replace pavement marking that is below 80 wet mils in thickness.
   1. No payment for materials placed in excess of 100 wet mils in thickness.

F. Use beads according to manufacturer's recommendations.

2.4 THERMOPLASTIC

A. Used for legends and symbols only on all pavement surfaces.

B. Heat-fused preformed and Hot Melt pavement marking materials.

C. Minimum Service Life for Legends and Symbols under all traffic volumes and wear conditions:
   1. Legends and Symbols: 24 months.

D. Performance Measures for Retro-reflectivity and Durability.
   1. Minimum Level of Retro-reflectivity: 125 millicandelas.
   2. Minimum Durability: 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. Replace under the warranty terms.

E. Hot-melt Thermoplastic:
   1. Remove and replace legends and symbols that are below 80 wet mils in thickness.
   2. No payment for materials placed in excess of 100 wet mils in thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Conduct surface preparations according to manufacturer's recommendations.

3.2 APPLICATION

A. Apply Pavement Marking Materials according to manufacturer's specifications.

END OF SECTION

SECTION 02771

CURBS, GUTTERS, DRIVEWAYS, PEDESTRIAN ACCESS RAMPS, AND PLOWABLE END SECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing curbs, gutter transitions, driveways, pedestrian access ramps, and plowable end sections.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03310: Structural Concrete

G. Section 03390: Concrete Curing

H. Section 05120: Structural Steel

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. Curbs, gutters, driveways, disabled pedestrian ramps and plowable end sections may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

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

2.2 EXPANSION JOINT FILLER

A. Preformed material. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

A. Refer to Section 02056.

2.4 STEEL

A. Reinforcing: Refer to Section 03211. Deformed billet-steel reinforcing bars as specified.

B. Structural: Refer to Section 05120. As specified or as indicated on the plans.

2.5 DETECTABLE WARNING SURFACE

A. Detectable Warning Surface – In-line truncated dome pattern that meets the requirements of GW Series Standard Drawings. Provide a color that contrasts visually with the adjoining surfaces, either light-on-dark or dark-on-light. Acceptable products for installation are as follows:
   1. Polymer Composite Panel – Polymer Composite, homogenous integral color (UV stable), skid resistant, non-glare finished panel. Use for new construction or retrofit construction.
   2. Precast Concrete Panel – High strength concrete with high tensile stainless steel tendons, homogeneous integral color (UV stable), skid resistant panel. Use for new construction, or retrofit construction.

PART 3 EXECUTION

3.1 PREPARATION

A. Construct subgrade to plan elevations. Refer to Section 02056.

B. Place and compact fill material and untreated base course. Refer to Section 02056.

C. May use a slip form curb and gutter machine.

D. Dampen the untreated base course before placing concrete.

E. Curbs and Gutters: Refer to GW Series Standard Drawings.

F. Pedestrian Access Ramp: Refer to GW Series Standard Drawings.

G. Plowable End Section: Refer to GW Series Standard Drawings.

H. Forms: Refer to Section 02776.

3.2 PLACE CONCRETE

A. Furnish materials and construct structural concrete. Refer to Section 03310.
   1. Do not use mechanical vibrators.
   2. Hand tamp forms to eliminate honeycomb.
   3. Deposit concrete continuously when using a slip form machine.
   4. Use dowels as shown on the plans when placing curb on existing pavement.

3.3 FINISH CONCRETE

A. Round edges to a ½ inch radius.

B. Use a float to finish the top and front face of the curb and the top of the gutter.

C. Finish the traveled portion of the driveway with a broom finish.

D. Remove form marks or irregularities from finish surfaces.

3.4 JOINTS

A. Place joints perpendicular to the subgrade and as shown.

B. Contraction joints:
   1. ⅛ inch to $^{3}/_{16}$ thick steel plates.
   2. Space the joints every 10 ft.
   3. Remove the templates as soon as the concrete takes an initial set.
   4. Cut joint 1½ inches deep when using slip form method to place the concrete.

C. Expansion Joints:
   1. Place expansion joint every 30 ft.
   2. Expansion joint not required when using slip form method to place concrete, except at adjacent pavement, curb radius, sidewalk, or structures.
   3. ½ inch thick premolded expansion joint filler.
   4. Place joint filler between the curb and gutter and sidewalk, or structures.

3.5 CURE AND PROTECT CONCRETE

A. Cure the surface. Refer to Section 03390.

B. Seal the surface after curing. Refer to Section 03390.

3.6 DETECTABLE WARNING SURFACE

A. Polymer Composite Panel Installation:
   1. Install cast-in-place detectable warning panel directly into the finished plastic concrete surface in accordance with manufacturer recommendations. Provide a smooth transition between the panel and the surrounding concrete surface.
   2. Install surface applied detectable warning panel directly on existing concrete surface in accordance with manufacturers recommendations and installation procedures. Use mechanical fasteners to secure the panel to the existing surface. Caulk a smooth transition bead along beveled panel edge and surrounding concrete surface.

B. Precast Concrete Panel Installation:
   1. Place as shown on drawings. Install per manufacturer recommendations for cast-in-place or thin set method. Provide a smooth transition between the panel and the surrounding concrete surface.

END OF SECTION

SECTION 02776

CONCRETE SIDEWALK, MEDIAN FILLER, AND FLATWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing concrete sidewalk, median filler, and flatwork.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02721: Untreated Base Course

C. Section 03055: Portland Cement Concrete

D. Section 03152: Concrete Joint Control

E. Section 03390: Concrete Curing

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 ACCEPTANCE

A. Concrete Sidewalk, Median Filler, and Flatwork may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

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

B. Substitute higher class of concrete if desired.

C. Flatwork: High purity, chemically inert, unfading, and alkali-fast synthetic pigment coloring material.

2.2 EXPANSION JOINT FILLER

A. Preformed material. Refer to Section 03152.

2.3 UNTREATED BASE COURSE

A. Untreated Base Course. Refer to Section 02721.

2.4 EMBANKMENT MATERIAL

A. Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Construct subgrade to plan elevations and following Section 02056.

B. Place and compact fill material following Section 02056.

C. Concrete flatwork coloring:
   1. Conform to the samples provided by the Engineer.
   2. Provide a matching sample, 1 ft^2 for the Engineer's approval before placing concrete.
   3. Thoroughly mix color pigment in the concrete before placing.

D. Forms:
   1. Use approved concrete forms on all curves that transition smoothly from curves to straight section. Keep forms free of flat sections and sharp bends.
   2. Use wood, metal, reinforced fiberglass, or plastic forms free of warps or bends. Anchor securely in place.

3.2 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 with a moist wooden float.

D. Round edges to a ½ inch radius.

E. Brush to a transverse broom finish.

3.3 EXPANSION AND CONTRACTION JOINTS

A. Place joints perpendicular to the subgrade and at right angles to the longitudinal axis of the sidewalk or median.

B. Contraction Joints:
   1. Use ⅛ inch to $^{3}/_{16}$ inch thick steel plates.
   2. Space the joints 10 ft apart.
   3. Remove the steel plates as soon as the concrete initially sets.

C. Expansion Joints:
   1. Use ½ inch thick premolded expansion joint filler. Refer to Section 03152.
   2. Place expansion joint every 30 ft.
   3. Place joint filler between the sidewalk or median filler and the curb or adjacent pavement, sidewalk, driveway pavement, or structure.

3.4 CURE AND PROTECT CONCRETE

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 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 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: Unit Weight and Voids in Aggregate

C. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

D. AASHTO T 59: Standard Test Methods for Emulsified Asphalts

E. AASHTO T 96: Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

F. AASHTO T 104: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

G. AASHTO T 278: Surface Frictional Properties Using the British Pendulum Tester

H. AASHTO T 279: Accelerated Polishing of Aggregates Using the British Wheel

I. AASHTO TP 61: Determining the Percentage of Fractured Particles in Coarse Aggregate

J. UDOT Materials Manual of Instruction

K. UDOT Minimum Sampling and Testing Requirements

L. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Mineral Aggregate
   1. Test Reports
      a. Cover Material meets requirements of this Section, article 2.4.

B. Verification that asphalt/polymer emulsion meets Section 02745

C. Verification that asphalt/polymer supplier adheres to UDOT Quality Management Plan for Asphalt Emulsion 508.

D. Submit all documentation verifying asphalt application rates, chip application, and other calibration verification for applied materials during the chip seal operations to the Engineer on a daily basis, or as requested by the Engineer.

E. Provide vendor's bill of lading certifying the material was diluted in accordance with this Section, article 2.3.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material is in accordance with UDOT Minimum Sampling and Testing Requirements.

B. Price Adjustments – Cover Material Gradation
   1. Based on the number of samples per lot and the minimum pay factor.
   2. Pay Factors for aggregate gradation when tested in accordance with AASHTO T 27 and AASHTO T 11 are indicated in Table 1.

Table 1

Aggregate Gradation Pay Factors			
Sieve Size	Pay Factor*	**Type I** Acceptance	**Type II** Acceptance
½ inch	1.00 0.95 0.90 0.85 Reject		100.0 99.0 98.0 97.0 < 97.0
⅜ inch	1.00 0.95 0.90 0.85 Reject	100.0 99.0 98.0 97.0 < 97.0	70.0 - 90.0 69.5 - 91.5 69.2 - 92.0 68.0 - 92.0 < 68.0 and > 92.0
No. 4	1.00 0.95 0.90 0.85 Reject	0 - 15 15.1 – 16.0 16.1 – 17.0 17.1 – 18.0 > 18.0	0 - 10.0 10.1 - 10.5 10.6 - 11.0 11.1 - 12.0 > 12.0
No. 8	1.00 0.95 0.90 0.85 Reject		0.0 - 5.0 5.1 - 5.5 5.6 - 6.0 6.1 - 7.0 > 7.0
No. 200	1.00 0.75 0.50 Reject	0.0 - 1.0 1.1 - 1.5 1.6 - 2.0 > 2.0	0.0 - 1.0 1.1 - 1.5 1.6 - 2.0 >2.0

* Use the lowest individual pay factor for combined gradation
** Average of tests

PART 2 PRODUCTS

2.1 CATIONIC EMULSIONS

A. CRS-2A per Section 02745

B. CRS-2P per Section 02745

C. LMCRS-2 per Section 02745

2.2 HIGH FLOAT EMULSIONS

A. HFRS-2P per Section 02745

B. HFMS-2 per Section 02745

C. HFMS-2P per 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 meeting the requirements of Table 2.

Table 2

Chip Seal Cover Material Properties		
Unit Weight, see Note 1	AASHTO T 19	100 lb/ft^3, max
One Fractured Face	AASHTO TP 61	95% min.
Two Fractured Faces	AASHTO TP 61	90% min.
LA wear, see Note 1	AASHTO T 96	30% max.
Soundness	AASHTO T 104	10% max.
Flakiness Index	Materials MOI 8-933	17 max.
Stripping, see Note 1	Materials MOI 8-945	10% max.
Polishing, see Note 1 Performed on aggregate prior to crushing	AASHTO T 278, T 279	31 min.
Field Coating of Emulsified Asphalt Use project specified emulsion	AASHTO T 59	Rating of “Good”
Note 1: 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. Grade with the following limits to meet the specified test standard in AASHTO T 27 and T 11.

Table 3

Gradation Limits		
Sieve Size	Percent Passing	
	Type I	Type II
½ in		100
⅜ in		70-90
No. 4	100	0-10
No. 8	0 –15	0-5
No. 200	0 - 1	0-1

2.5 BLOTTER MATERIAL

A. Refer to Section 02748

2.6 TEMPORARY PAVEMENT MARKERS

A. Refer to Section 01558

2.7 EQUIPMENT

A. Use distributor trucks meeting 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 which 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. Regulation of the pressure of the material application and automatic adjustment of rate control to the unit ground speed.
        1) Hydrostatic system capable of maintaining a tolerance of ± 0.3 gal/yd^2.
    b. Adjustment of the spray bar height and width 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 which 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/yd^2.
    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 a minimum of 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/in^2, or lower as approved by the Engineer.
            1) Maintain tire pressure within 5 lb/in^2.

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 by means of a truck mounted spinner broadcast spreader or other equipment as approved by the Engineer.

G. All equipment is subject to inspection and approval by the Engineer.

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 guardrail, guideposts, concrete barriers, parapet walls, etc.

C. Cover manholes, valve boxes, drop inlets and other service utility entrances before placing any chip seal coat.

D. Stockpile blotter material, a minimum of 0.25 lb/yd^2 meeting the requirements of Section 02748 at a site within twenty minutes delivery time of each road section being chip sealed, and have on site application equipment before beginning chip seal work.
   1. Upon Engineer approval, stockpiling of blotter material may be waived if blotter material can be obtained and ready to spread within twenty minutes of a road section being chip sealed.
   2. 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 can not 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 14 hours after placing cover material.

F. Apply bituminous flush coat material after receiving approval from the Engineer, but no earlier than 48 hours 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 to facilitate uniform dampening. Avoid excess moisture.

3.4 TEMPORARY PAVEMENT MARKER APPLICATION

A. Refer to Section 01558.

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 any of the following conditions apply:
   1. Material does not meet the required viscosity.
   2. 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 4.
   1. Maintain a distance of less than 150 ft between the distributor and the chip spreader.
   2. Maintain the chip spreader speed such that chips do not bounce or roll upon application.

Table 4

Approximate Spread Rates	
Unit Weight lbs/ft^3	**Application Rate lbs/yd^2**
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 a minimum of three pneumatic-tire rollers in a longitudinal direction to roll surface after the cover material has been spread.

B. Roll a minimum of 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 directed by the Engineer.

D. Set the roller speed to prevent bouncing or skidding, not to exceed 5 mph.
   1. Reduce roller speeds during directional changes to prevent tearing of the surface.
   2. Repair all damage done to the seal coat by the rollers.

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 2500 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.

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, ± 0.01 gal/yd^2.
   1. Keep traffic off the flushed surface until the bituminous material has set sufficiently to prevent tracking or pick-up.
   2. Allow a minimum of 24 hours before applying permanent application of traffic striping or markings after completing flush seal.

3.8 TRAFFIC CONTROL

A. Refer to Section 01554

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 01452: 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 Abrasion of Small Size Coarse Aggregate by Use of 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 TP 61: Determining the Percentage of Fractured Particles in Coarse Aggregate

M. UDOT Quality Management Plans

N. UDOT Materials Manual of Instruction

O. UDOT Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Job mix gradation: at least 10 working days before paving.
   1. Submit materials and documentation according to Materials Manual of Instruction, Section 954.
   2. Aggregate suitability test results.

B. Changes in job mix gradation:
   1. Submit a written request for a change in a job-mix gradation.
   2. Allow the Engineer five working days to review and approve the changes and to readjust the quantity of asphalt binder to be used.

C. Verification that Hydrated Lime meets the requirements of Section 02746.

D. Verification Asphalt Binder meets the requirements of Section 02745.

1.6 ACCEPTANCE

A. Acceptance sampling and testing of material 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 agreed upon in advance by both the Contractor and 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: 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. AASHTO T 308.
   a. Apply incentive to the entire lot.
   b. Disincentive is applied only to the sublot defined as 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: Department will compute incentive/disincentive for gradation is based on Percent Within Limits computation using Table 2, 3, 4, and 5. 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 ¼ inch.

D. Smoothness
1. Determine acceptance and correct. Refer to Section 01452.

E. Submit an engineering analysis within one week if requesting that a rejected lot or sublot remain in place.
1. Include in the analysis: Data and engineering principles that indicate why the pavement should remain in place.
2. The Engineer, Region Materials Engineer, and District Engineer review the analysis for acceptance, denial, or revision within three working days.
3. Remove the rejected material from the project within 72 hours and replace it with an acceptable material if the request is denied.
4. Agree on removal time period If rotomilling is required.
5. Department deducts $20/ton if a rejected lot or sublot is allowed to remain in place.

Table 1

Incentive/Disincentive for Binder Content	
Binder Content	**Pay Adjustment in $/ton OGSC**
Within ± 0.30% of target	+1.00
Between ± 0.31% and ± 0.45% of target	0.00
Between ± 0.46% ± 0.60% of target	-2.00
Greater than ± 0.61%	Reject

Table 2

Gradation Upper and Lower Limit Determination	
Parameter	UL and LL
⅜ inch sieve	Target Value ± 6.0 percent
# 4 sieve	Target Value ± 6.0 percent
# 8 sieve	Target Value ± 5.0 percent
# 200 sieve	Target Value ± 2.0 percent

Table 3

Incentive/Disincentive for Gradation	
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 place accuracy which will be carried through all further calculations. Rounding to lower accuracy is not allowed.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Refer to Section 02745.

B. Sampling procedure: UDOT Quality Management Plan - 509 Asphalt Binder.

2.2 HYDRATED LIME

A. Meet the requirements of 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, to determine the acceptability of the aggregate.
   1. Coarse aggregate:
      a. Retained on # 4 sieve.
   2. Fine aggregate:
      a. Clean, hard grained, and angular.
      b. Passing the # 4 sieve.

Table 6

Aggregate Properties		
Properties	**Test Method**	**Test Requirement**
One Fractured Face	AASHTO TP 61	95 percent min.
Two Fractured Face	AASHTO TP 61	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 approval 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
⅜ inch	90 - 100
# 4	35 - 45
# 8	14 - 20
# 200	2 - 4

PART 3 EXECUTION

3.1 MIX

A. Mix until all particles are coated.

B. Treat aggregate with hydrated lime according to the requirements of 02746.
   1. Verify lime slurry equipment is operating at all times when using Method A.
      a. Cease production if hydrated lime slurry treatment is interrupted.
      b. Engineer may require marination of the aggregate/hydrated lime mixture in the stockpile, Method B, if production continues without hydrated lime slurry treatment.

3.2 SURFACE PLACEMENT

A. Apply the tack coat at a uniform rate. Refer to Section 02748.
   1. 0.10 gal/yd^2 on new pavement
   2. 0.15 gal/yd^2 on milled surfaces

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 directed by the Engineer.

3.3 LIMITATIONS

A. Place between May 1 and September 15.
   1. Obtain written approval 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 during other adverse weather conditions.

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 a 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: Standard Specification for Mineral Filler for Bituminous Paving Mixtures

B. AASHTO M 29: Standard Specification for Fine Aggregate for Bituminous Paving Mixtures

C. AASHTO M 208: Standard Specification for 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 Minimum Sampling and Testing Requirements

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit Mix Design and test results to the Engineer 10 days prior to beginning construction.
   1. Meet the requirements of this Section, article 2.7.
   2. Include target gradation for combined aggregate and mineral filler.

B. Provide test reports for aggregate.
   1. Meet the requirements of this Section, article 2.2.

C. Provide a Manufacturer's Certificate of Compliance for Mineral Filler.

D. Provide verification that the emulsified asphalt supplier adheres to UDOT Minimum Sampling and Testing Requirements Section 508 Asphalt Emulsion Quality Management Plan.
   a. Provide a certificate of analysis/compliance from the manufacturer for each shipment.

PART 2 PRODUCTS

2.1 EMULSIFIED ASPHALT

A. Use a cationic emulsified asphalt grade CQS-1H as specified in AASHTO M 208.

B. Use a polymer modified emulsion CQS-1HP, meeting CQS-1H specifications identified in AASHTO M 208 and ISSA A 105, using solid synthetic rubber or latex material.
   1. Combine the polymer modifier with the base asphalt or asphalt emulsion at a minimum rate of 3 percent solids by weight of asphalt, prior to loading at the manufacturing plant.
   2. Use a polymer modified emulsion compatible with the mix design developed for the conventional slurry seal.

C. Verify that the shipment is the same as the mix design.

D. Adhere to UDOT Minimum Sampling and Testing Requirements Section 508 Asphalt Emulsion Quality Management Plan.

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 $Na_2 SO_4$. 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 stockpile tolerance and still remain within the gradation band. Refer to AASHTO T 11, AASHTO T 27, and Table 1.

Table 1

Gradation		
Sieve Size	**Gradation Band (% Passing)**	**Stockpile Tolerance**
⅜ 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. Provide the Engineer with the test results and the proposed mix design from a UDOT approved laboratory conforming to the following tests in ISSA A105.
   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 Max.
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 degreed F and falling. 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 a minimum of one and a maximum of seven days prior to use.

B. Notify the Engineer a minimum of seven calendar days prior to 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 prior to 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 prior to 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 prior to surfacing.

3.4 APPLICATION

A. Pre-wet the entire surface by fogging ahead of the slurry box. 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. Avoid overloading the spreader.

C. Apply slurry mixture of proper consistency at an average rate of 18 to 22 lb/yd^2.

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. Do not allow over-lap on these areas.

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 prior to 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 02812

PRESSURIZED IRRIGATION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aboveground, underground, and drip irrigation systems complete with heads, valves, controls, and accessories.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. ASTM B 88: Copper Pipe

B. ASTM B 687: Brass, Copper, and Chromium-Plated Pipe Nipples

C. ASTM D 1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated poly (Vinyl Chloride) (CPVC) Compounds

D. ASTM D 1785: Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80, and 120

E. ASTM D 2464: Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 80

F. ASTM D 2466: Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings; Schedule 40

G. ASTM D 2672: Joints for IPS PVC Pipe Using Solvent Cement

H. ASTM F 656: Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

I. ASSE 1013, 1015: Backflow Preventers, Pressure Reducers

1.4 DEFINITIONS

A. Mainline: The system of pipes that carry water from the Point of Connection (POC) to the valves.

B. Lateral Lines: The system of pipes that carry water from the valves to the sprinkler heads or emitters.

1.5 SUBMITTALS

A. Product Data: Manufacturer's technical data and installation instructions.

B. Certificates of compliance to Engineer prior to installation.

C. As-Built Drawings: Red-lined plan layout and details illustrating mainline and lateral lines location, size, and assembly. Include type and coverage of heads, type of valves, controllers, fittings and accessories.

D. Operating and Maintenance Data:
   1. Instructions covering full operation, care, and maintenance of system and controls and manufacturers parts catalog. Include drain procedures, blow out features for example.
   2. Instruct maintenance personnel in proper adjustment of sprinkler heads and use of special tools for adjustments.

E. Keys:
   1. Gate Valve Key.
   2. Stop and Waste Valve Key: "T" handle, rigid steel, 5 ft long minimum, key end to fit the stop and waste valve nut.

1.6 PERFORMANCE REQUIREMENTS

A. Location of sprinkler heads: Design location is approximate.
   1. Adjust as necessary to avoid existing plants and other obstructions.
   2. The number of heads or valves cannot be less than indicated on the plans.

B. Water Coverage:
   1. Head to head coverage in turf and other planting areas (100 percent).
   2. Do not increase or decrease number of heads or size of pipe indicated unless approved by Engineer.

C. PVC Pipe: Must be stamped with certified NFS.

D. Drain the system at the end of each work day if work is to continue after November 1, or resume before April 15. Do not permit water to remain in pipe overnight.

E. Verify and mark the location of all utilities and underground obstructions.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Mainline: Solvent welded schedule 40 PVC through 1½ inch, then Class 200 PVC. ASTM D 1784 and ASTM D 1785.

B. Lateral line: Solvent welded schedule 40 PVC through 1½ inch, then Class 200 PVC. Meet ASTM D 1784 and ASTM D 1785.

C. Pipe Fittings: Solvent welded schedule 40 PVC. Meet ASTM D 2466.

D. Valve Fittings: Solvent welded schedule 40 PVC. Meet ASTM D 2464.

E. Risers: Threaded schedule 80 PVC. Meet ASTM D 2464.

F. Copper Pipe: Type K as specified in ASTM B 88.

G. Copper Fittings: Wrought or cast as specified in ASTM B 687.

2.2 VALVES

A. Automatic Control Valve:
   1. Body made of high-strength, non-corrosive PVC material.
   2. Pressure regulating set at 50,750 psi.
   3. Slow and smooth opening and closing with a manual flow control and internal bleed screw.
   4. Highly efficient, totally encapsulated 24 VAC solenoid.
   5. High-strength rubber or synthetic rubber diaphragm.

B. Gate Valve: Threaded brass construction, 200 psi rated (minimum) and sized according to main line.

C. Manual Drain Valve: ¾ inch bronze body, angle valve with replaceable seat disc and brass cross handle.

2.3 BACKFLOW PREVENTER

A. Bronze body and caps constructed with wear and corrosion resistant internal parts complete with bronze quarter turn ball valves.

B. Reduced Pressure Principle Device (RP) as specified in ASSE 1013.

C. Double Check Valve (DCV) as specified in ASSE 1015.

D. Capable of being tested and serviced without removal of device from the line.

2.4 AUTOMATIC CONTROLLER

A. General: A commercial grade controller manufactured expressly for control of automatic valves and underground irrigation systems and equipped with the following minimum features.
   1. Twelve hour duration for any or all stations.
   2. Four programs, with eight start times each.
   3. Two master valve terminals, one programmable by station.
   4. Three hundred sixty-five day calendar with leap year intelligence.
   5. Event day off option.
   6. Programmable rain delay.
   7. Water budget by program with adjustments from 0 to 300 percent in one percent increments.
   8. Capable of having total run time split into usable cycles.
   9. Manual or automatic operation.
   10. Non-volatile.
   11. Battery backup.
   12. Heavy-duty electrical surge protection.
   13. UL listed; CSA, CE approved

B. Transformer: Capable of converting service voltage to control voltage in accordance with manufacturer's recommendations.

2.5 PEDESTAL

A. Free-standing unit with a weather resistant coating typically specified for the controller. Hardware included.

2.6 SPRINKLER HEADS

A. Fixed Riser
   1. ½ inch x 24 inch schedule 80 riser Male Pipe Threads (MPT).
   2. ½ inch shrub head adaptor Female Pipe Threads (FPT) x MPT.
   3. ½ inch FPT barbed swing pipe adapter.

B. Pop-up Spray Head
   1. Made of plastic and stainless steel materials.
   2. Pop-up risers of 4 inch, 6 inch, and 12 inch.
   3. Stainless steel retraction spring.
   4. Ratcheting mechanism.
   5. Side and bottom inlets on 6 inch and 12 inch heads.

C. Rotary Head
1. High-impact plastic construction with stainless steel ratcheting riser.
2. Four-inch minimum pop-up with water-lubricated gear driven design.
3. Integral rubber cover.
4. Heavy-duty, stainless steel retraction spring.
5. Built-in check valve.

D. Pop-up Impact Head
1. High-impact plastic construction with plastic clapper.
2. Four-inch pop-up design with internal wiper seals.
3. Heavy-duty, stainless steel retraction spring.
4. Built in check valve required when used with more than 3 feet of elevation change on the lateral line.
5. Plastic Sprinkler Nozzles
   a. Interchangeable.
   b. Matched precipitation.
6. Three quarter inch side or bottom inlet.

E. Above-ground Impact
1. Brass construction with stainless steel clapper.
2. Mounted above ground with no pop-up features.
3. Four-inch riser mounted impact.
4. Three quarter inch MPT inlet.
5. Brass Sprinkler Nozzles.
   a. Interchangeable.
   b. Matched precipitation.

2.7 PLASTIC NOZZLES

A. Fixed Spray
1. Radius patterns and gal/min as shown on plans.
2. Matched precipitation rates.
3. Stainless steel adjustment screw.
4. FPT to match ½ inch shrub head adapter.
5. Pressure regulating: Required when the psi at the sprinkler does not fall within the range recommended for its use. See manufacturer's specifications.
6. Filter screen.

B. Bubbler
1. Made of high-impact plastic.
2. Pressure compensating with adjustable flow and radius as shown on plans.
3. Half inch FPT.
4. Attach to fixed riser or pop-up spray.

5. Filter screen.

2.8 DRIP TUBING

A. Self cleaning, pressure compensating, polyethylene dripperline.

B. Dripper discharge: 0.6 gal/hr to 0.9 gal/hr and choice of 12 inch, 18 inch, or 24 inch spacing.

C. Pressure compensation range from 8 psi to 60 psi.

D. 0.63 inch (±0.01 inch) outside diameter; 0.54 inch (±0.01 inch) inside diameter.

2.9 LINE FLUSH VALVE

A. Made of high impact plastic.

B. Maximum flow rate per flush valve: 15 gal/min.

C. Automatic cleaning operation.

D. Can be disassembled allowing for winterization blow-out.

E. ½ inch MPT threads.

2.10 AIR/VACUUM RELIEF VALVE

A. Brass body and cap and rated to 200 psi.

B. Temperature resistant silicone disc seat.

2.11 DISK FILTER

A. Corrosion resistant thermoplastic design.

B. Multiple disk filter design: 120 mesh.

C. One inch MPT threads.

D. Shut-off valve.

E. Constructed of durable, non-corrosive components and equipped with O-ring seals.

2.12 "Y" FILTER

A. One inch threaded inlet and outlet.

B. One hundred mesh polyester filter screen.

C. Constructed of durable, non-corrosive components and equipped with an O-ring seal.

D. Operating flow range of 1 gal/min to 15 gal/min with a pressure range of 10 psi to 150 psi.

E. Easy removable cap and screen.

2.13 SWING PIPE

A. Flexible Polyethylene Pipe: Maximum flow 6.0 gal/min. Inside diameter of ½ inch (±0.01 inch) with a wall thickness of $^{3}/_{32}$ inch (±0.01 inch) and 80 psi rated.

B. Flexible Polyethylene Pipe: For flows exceeding 6 gal/min. Inside diameter of $^{15}/_{16}$ inch (±0.01 inch) with a wall thickness of $^{3}/_{32}$ inch (±0.01 inch) and 80 psi rated.

C. ½ inch Barbed Male Elbow: Plastic

D. ¾ inch Barbed Male Elbow: Plastic

E. 1 inch Barbed Male Elbow: Plastic

2.14 VALVE BOX

A. Precast concrete or plastic with adequate hand room to operate small tools and provisions for locking cover to frame.

2.15 WIRE

A. Provide wire for connecting remote control valves to the automatic controllers that is Type "UF", 600 V, stranded or solid copper, single conductor wire with PVC insulation and bearing UL approval for direct underground burial feeder cable.
   1. Make all connections with UL approved type seal to make a waterproof connection.
   2. Bury wires in the same trench as the pipe where possible.

B. Provide wire with 0.060 inches insulation, minimum covering of ICC-100 compound for positive weatherproofing protection.
   1. Use a single conductor solid copper wire for wire sizes 14, 12, 10, and 8. Use stranded copper wire for sizes 6 and 4.
   2. Make control or “hot” wires red and all common or “ground” wires white.

2.16 QUICK COUPLER

A. Constructed of heavy duty brass with a ¾ inch one-piece body design.

B. Operating flow range of 10 gal/min to 50 gal/min with a pressure range of 5,000 psi to 101,500 psi.

C. ¾ inch brass valve key.

D. ¾ inch brass swivel hose ell.

E. Stainless steel spring.

2.17 WASHED AGGREGATE

A. 1½ inch maximum with 100 percent retained on a No. 4 sieve.

2.18 JOINT PRIMER AND SOLVENT CEMENT

A. Refer to ASTM F 656 and ASTM D 2672.

2.19 ACCESS SLEEVE

A. 2 inch, Schedule 40 PVC with a yellow rubber cap.

2.20 TEFLON TAPE

A. Use quality grade, domestically made 0.004 inch (± 0.001) on threaded joints.

2.21 CLASS B CONCRETE

A. Refer to Section 03055.

PART 3 EXECUTION

3.1 EXCAVATION

A. Stake pipe and sprinkler locations for approval.

B. Excavate trenches for sprinkler system pipe to provide 18 inches of cover over main lines and 9 inches over lateral lines.
   1. Do not damage roots where trenching is required in proximity to trees that are to remain.

C. Barricade trenches within the clear zone and along pedestrian routes that are left open overnight.

3.2 INSTALLATION

A. General: Plans are diagrammatic. Proceed with installation in accordance with the following:
   1. Install stop and waste valves, backflow preventors and other equipment required by local authorities according to Utah Laws and Regulations to make system complete.
   2. Install main line, automatic control valves, lateral lines, fittings, and heads/drip line as specified.
   3. Thoroughly flush main lines before installing automatic control valves, and laterals before installing sprinklers. Flush supply lines thoroughly before installing backflow preventers or other regulating devices.
   4. Adjust heads to be plumb and flush with finished grades, even with top of soil level or top of material level after completion of grading, seeding or sodding, and rolling of grass areas.

B. Piping: Assemble all mainline and lateral lines in accordance with manufacturer's recommendations with no cul-de-sacs.
   1. Pack the opening around the pipe with non-shrink grout at wall penetrations. Fill perimeter slot with backer rod and sealant at exterior face. Repair below grade waterproofing and make penetration watertight.
   2. Install PVC pipe in dry weather above 40 degrees F as specified by manufacturer's recommendations. Allow joints to cure a minimum of 8 hours before testing.

C. Sleeving: Coordinate sleeving installation before placing pavement.

D. Control Valves:
   1. Install at plan locations and according to detail. Use Schedule 80 PVC pipe for nipples on valve header, length as necessary. Install valves two maximum per each standard, plastic valve box and provide 12 inches of expansion loop slack wire at all connections inside valve box.

E. Manual Drains: Install at locations indicated on plans and according to detail.

F. Quick-Coupling Valves: Install using ¾ inch Schedule 80 PVC nipples for risers and elbows. Locations as indicated on plans.

G. Backflow Preventers:
   1. Install assembly using the detail.
   2. In below grade installations, provide washed aggregate drain sump.

H. Valve Access Boxes:
   1. Install over all automatic control valves, manual control valves, or zone shutoff valves and sized to provide adequate room for maintenance.
   2. Install valve boxes flush with finish grade and place parallel or perpendicular to adjacent curbs, sidewalks, or driveways.
   3. Imprint a valve control number on each valve box cover that corresponds to the valve controller clock. Print the valve box number a minimum of one inch high in a permanent and legible manner.
   4. Place washed aggregate in sump as shown on plans.

I. Automatic Controller:
   1. Stake or mark controller location for approval.
   2. Mount the panel enclosure so the operator can conveniently make adjustments.
   3. Properly ground controller in accordance with Utah Laws and Regulations. Make all control wire connections to automatic controllers. Coordinate controller installation with electrical work.
   4. Pour the concrete pedestal base with inserted conduits and bolts if pedestal controller is used.
   5. Provide a laminated copy of the irrigation plan indicating valve station numbers and field locations and attach it inside the controller.
   6. Program the controller to provide the appropriate amount of water for each station.
   7. Supply the Engineer with manufacturer's warranties and operating instructions for the controller.

J. Wire and Electrical Work:
   1. Use electrical control and ground wire suitable for sprinkler control cable of size indicated on plans.
   2. Tape control wires to underside of pipe at 15 ft intervals.

K. Spray Heads, Fixed Risers and Bubblers:
   1. Install as per plans.
   2. Adjust sprinkler nozzles to allow for adequate coverage and minimize overspray onto walks, roads, driveways, and buildings.

3.3 TEST

A. Notify the Engineer 24 hours in advance of pressure testing the main line.

B. Hydrostatic pressure test all supply and pressure irrigation lines by maintaining full supply line water pressure for three consecutive hours before backfilling and after air pockets have been vented from the lines.

C. Test connections for leaks prior to backfilling and repair all leaks. Lateral lines may be tested in sections to expedite backfilling work.

3.4 BACKFILL OPERATION

A. Bed all pipe a minimum of 2 inches, surrounding the pipe with native material excavated from the trench and passing through a ½ inch sieve.

B. Prevent soil, rocks, or debris from entering pipes or sleeves.

C. Compact backfilled trenches thoroughly to prevent settling damage to grades or plant materials. Repair irrigation system and plants at no additional cost to Department.

3.5 IRRIGATION INSTALLATION INSPECTION

A. Notify the Engineer to schedule the inspection with the Region Landscape Architect after the irrigation system is completely installed and fully functional.

B. Make the required field adjustments and changes after the inspection.

END OF SECTION

SECTION 02821

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing 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 280: Zinc-Coated (Galvanized) Steel Barbed Wire

E. AASHTO M 305: Aluminum Coated Steel Barbed Wire

F. ASTM A 392: Zinc-Coated Steel Chain-Link Fence Fabric

G. ASTM A 491: Aluminum-Coated Steel Chain-Link Fence Fabric

H. ASTM F 1083: Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

PART 2 PRODUCTS

2.1 GENERAL

A. Class B Concrete. Refer to Section 03055.

2.2 POSTS, CAPS, RAILS, AND COUPLINGS

A. Pipe posts and rails:
   1. Schedule 40, hot-dip galvanized coated pipe. ASTM F 1083.

B. Fitting: malleable cast iron or pressed steel coated as specified. AASHTO M 232.

C. Caps: AASHTO M 232
   1. Equip all pipe posts with a galvanized steel or malleable iron weather-resistant cap, designed to fit securely over the posts and carry an apron around the outside of the post.
   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. Refer to AASHTO M 181, ASTM A 392, and ASTM A 491.

B. 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.

C. Provide 0.177 inch diameter spiral material for tension wires.

D. Tie fabric to supporting members of the same diameter as the fence fabric.

2.4 BARBED WIRE

A. Provide zinc-coated barbed wire when zinc-coated fence is used. Refer to 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. Refer to AASHTO M 305.

D. Support arm on the fence for barbed wire must support a 200 lb vertical load at the end of the arm without causing permanent deflection.

2.5 GATES

A. Construct gate posts and frames of the sizes following 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 as specified. AASHTO M 111.
   3. Do not use closed cells that would prohibit dipping to 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 following FG Series Standard Drawings.

B. Do not exceed the following spacing requirements when placing posts:

Radii of Curve	Maximum Post Spacing
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 or at angle points of 30 degrees or more.

D. Set posts in concrete walls or masonry where required.
   1. Set posts or post sockets in concrete walls to a minimum 18 in depth.
   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 sulfur caulk or other expansive grout to fasten the post in the socket.

E. Set posts in concrete bases.
   1. Place concrete a minimum of 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.

3.2 INSTALL FENCE FABRIC

A. Place 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 material to end, gate, corner, and pull posts.
   2. Space metal bands at 1 ft intervals along the post.
   3. Cut the fabric at all pull and corner posts.
   4. Fasten fabric to line posts with tie wires or metal bands at 14 inch intervals.
   5. Attach the top edge of fabric to the top rail or tension cable with wire ties at approximately 24 inch intervals.
   6. Attach bottom of fabric to bottom tension wire, and 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 specified. 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 fence 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. Materials and procedures for constructing 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 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. AASHTO M 279: Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric

D. AASHTO M 280: Zinc-Coated (Galvanized) Steel Barbed Wire

E. ASTM A 39: Zinc Coated Chain-Link Fence Fabric 2

F. ASTM A 116: Metallic-Coated, Steel Woven Wire Fence Fabric

G. ASTM A 641: Zinc-Coated (Galvanized) Carbon Steel Wire

H. ASTM A 702: Steel Fence Posts and Assemblies, Hot Wrought

I. 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 a 6 inch vertical wire spacing.

C. Class I zinc coating.

2.2 V-MESH FENCE

A. Two 50-inch sections of V-mesh fencing material with doubled and twisted 12½ gauge line wires with 14 gauge V-wires. Refer to ASTM A 116.

B. Heavy gauge chain-link, galvanized 9-gauge 2⅜ inch mesh as an alternative. Refer to ASTM A 39.

2.3 BARBED WIRE

A. Galvanized barbed wire as specified. 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 UNTREATED WOOD POSTS FOR LINES, GATES, ENDS, AND CORNERS

A. Native juniper or approved equal.

B. Line posts must have a minimum circumference of 10 inches.

C. Gate, brace, and corner posts much have a minimum circumference of 12 inches.

D. All posts must be sound, free of decay or defects, and structurally suitable.

2.5 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 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 minimum diameter of 5 inches.
3. Rectangular posts must have a minimum dimension of 4 inches x 6 inches.
4. Square members, a minimum of 4 inches x 4 inches may be rough sawn or S4S.
5. A line drawn between the centers of the butt and tip of each post and brace rail must be inside of the actual longitudinal centerline of the post or rail within 1.67 percent of its length.
6. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
7. Fabricate posts and brace rails before pressure treatment of the wood members.
8. Field drill only after all exposed untreated surfaces of members are field treated with two coats of the same material as they were originally treated.
9. Refer to Section 06055 for post and brace rail treatment.
10. Keep round posts free of bark, protruding knots, or other irregularities.

2.6 METAL POSTS AND BRACES (BRACE POSTS)

A. Refer to ASTM A 702.

B. Coat fasteners as specified for Class 1 Coating. Refer to ASTM A 641.
   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.
   2. Galvanized posts may be used in the place of painted posts if the galvanizing is a hot-dipped process. Refer to AASHTO M 111.

2.7 TUBULAR-STEEL FRAME GATE WITH WIRE FABRIC

A. 1 inch diameter pipe gate frames as specified.

B. Place pipe braces vertically in each drive gate to provide uniform size panels.
   1. 10 ft and 12 ft gates must have 1 vertical support.
   2. 14 ft and 16 ft gates must have 2 vertical supports.

C. Dimension shown on the plans and in the specifications are the minimum clear openings between gate posts. The supplier must provide a gate with fittings to fill the opening.

D. Use galvanized woven fabric on the mesh wire fences of the same type and quality as specified for the fence and gates.
   1. Space horizontal wires corresponding to that of the fence.
   2. Provide an adjustable truss rod of ⅜ inch minimum diameter to prevent sagging on gates 10 ft or more in length.

E. Supply hot-dipped galvanized steel fittings as specified. Refer to AASHTO M 232.

F. Pintles for 10 ft and wider gates must be ⅝ inches in diameter or larger.

G. Frame and walk gates must be made of 1 inch galvanized steel tubing.

H. Fastener and single gates must be a 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.

2.8 STAPLES

A. Galvanized No. 9 wire staples at least 1½ inches in length.

2.9 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 following FG Series Standard Drawings.

2.10 CONCRETE

A. Class B(AE) 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.

E. Cut wood posts to the designated height and slant top at an approximate 30 degree angle.

F. Use a ⅜ 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. 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 all sags from wire mesh fabric without causing tension crimps to fail.
   1. Every alternate lateral wire in the mesh fabric.
   2. Each strand of barbed wire to the post.

K. Install grounds anywhere electric transmission, distribution, or secondary lines cross a wood post fence, conforming to industry standard. 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.

M. Install all fences following FG Series Standard Drawings.

END OF SECTION

SECTION 02825

CATTLE GUARD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing Precast Cattle Guard.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02316: Roadway Excavation

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 05120: Structural Steel

1.3 REFERANCES

A. AWS D1.1: Structural Welding Code-Steel

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 CONCRETE

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

2.3 STEEL

A. Reinforcing Steel: Refer to Section 03211.

B. Structural Steel: Refer to Section 05120.

2.4 AGGREGATE

A. Granular Backfill Borrow: Refer to Section 02056.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove and replace unacceptable material. Refer to Section 02316.

B. Compact existing materials to a minimum 1 ft depth in compliance with Section 02056.

C. Cover properly excavated foundation with 2 ft of granular backfill borrow.
   1. Hand screed to the required grade utilizing properly placed screed rails.
   2. Refer to SW series Standards Drawings.

D. Place the Precast Concrete Cattle Guard on the granular backfill borrow.

E. Construct welded end guard unit and Cattle Guard following SW series Standard Drawing.

F. Welding needs to be done in accordance with AWS D1.1 Structural Welding code-Steel.

END OF SECTION

SECTION 02827

WILDLIFE ESCAPE RAMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing Wildlife Escape Ramps.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02231: Site Clearing and Grubbing

C. Section 02822: Right-of-Way Fence and Gate

D. Section 02911: Mulch

E. Section 02912: Topsoil

F. Section 02922: Seed, Turf Seed, and Turf Sod Section

G. Section 06055: Timber and Timber Treatment

1.3 REFERENCES

A. ASTM A 116: Zinc Coated (Galvanized) Steel V-mesh Fence Fabric

1.4 DEFINITIONS

A. 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 as shown on FG Series Standard Drawings.

B. High Migratory Wildlife Escape Ramps: Three earthen ramps, two opposite each other and perpendicular to the right-of-way fence plus one between them parallel to the right-of-way fence creating a three-sided corral for animals to jump into to escape from the right-of-way as shown on 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, or any other defect and structurally suitable. Refer to Section 06055.

2.2 ROUND TIMBER

A. Use timber according to Section 02822.

2.3 WIRE MESH FENCE

A. Refer to ASTM A 116.

B. Two 50-inch sections of galvanized V-mesh fencing material with doubled and twisted 12½ gauge line wires with 14 gauge V-wires as shown in the Deer Barrier Right-of-Way Fence, Type G, on the FG Series Standard Drawings.

C. Class I zinc coating.

2.4 NAILS OR SCREWS

A. Use 16d galvanized nails or 4 inch galvanized wood screws.

2.5 BORROW

A. Borrow. Refer to Section 02056.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate Wildlife Escape Ramps by type as identified in the plans.

B. Clear and grub within the footprint of the Wildlife Escape Ramp according to Section 02231. Strip and stockpile 4 inches of topsoil.

C. Install vertical posts for the escape ramps, end panels, and brace panels as shown in the Wildlife Escape Ramp Detail on FG Series Standard Drawings. Place end panels on both sides of the Wildlife Escape Ramp openings. Place brace panels on each end of the 24 ft 9 inch drift fence. Refer to FG Series Standard Drawings.

D. Securely fasten ends of the nominal 2 inch x 8 inch planks to the posts with 16d nails or 4 inch wood screws as shown in the Wildlife Escape Ramp Detail. Refer to FG Series Standard Drawings.

E. Install V-mesh fencing fabric for ROW Fence and Gates – Deer Barrier. Remove V-mesh fencing material above ramps to create an opening. Refer to FG Series Standard Drawings.

F. Place borrow material for ramp as shown on the isometric view. Refer to FG Series Standard Drawings.

G. Cover the Wildlife Escape Ramp with topsoil, seed, and mulch upon completion of borrow placement. 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 01554: Traffic Control

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 02842: Delineators

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. Manufacturer's certificate of compliance Acceptable
   1. Certification to be included in project file.

PART 2 PRODUCTS

2.1 W-BEAM GUARDRAIL AND HARDWARE

A. W-Beam Rail:
   1. Minimum galvanizing requirement: AASHTO M 180, Type 1, Class A

B. Bottom W-Beam rail or steel rub rail:
   1. W-Beam: meet requirements, of this section.
   2. Channel rub rail: meet AASHTO M 160 and AASHTO M 270
      a. Meet AASHTO M 111 after all punching and cutting is complete.

C. Hardware:
   1. Manufacturer: meet AASHTO M 180
   2. Coatings: meet 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: meet AASHTO M 270 and AASHTO M 160.
      a. Meet AASHTO M 111 after all 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 as to meeting NCHRP 350 test requirements
   4. Visually inspected and accepted by the Engineer

2.3 TRANSITION ELEMENTS

A. All elements as per BA Series Standard Drawings.
   1. Meet the requirements of this section for W-Beam guardrail, posts, blocks, and hardware.

B. Chose appropriate curb section per plan requirement and BA series Standard Drawings.

2.4 ANCHOR ELEMENTS

A. All elements as per BA Series Standard Drawings.
   1. Meet the requirements of this section for W-Beam guardrail, posts, blocks, and hardware.
   2. Anchor Plate: Meet AASHTO M 270.
      a. Meet AASHTO M 111 after all punching, drilling and cutting is complete.
   3. Bearing Plate: Meet AASHTO M 270
      a. Meet AASHTO M 111 after all punching drilling and cutting is complete.
   4. Anchor Post Foundation Tube and Plate:
      a. Tube: Meet ASTM A 500
      b. Plate: Meet AASHTO M 270
      c. Meet AASHTO M 111 after all punching, drilling, cutting and welding is complete.

2.5 W-BEAM BURIED-IN-BACKSLOPE TERMINALS

A. All elements as per BA Series Standard Drawings.
   1. See plan set for terminal requirement.
   2. See BA Series Standard Drawings for Buried-In-Backslope Terminal Anchor options.
      a. Steel Post with plate: meet AASHTO M 270 and AASHTO M 160. Meet AASHTO M 111 after all punching, drilling, cutting and welding is complete.
      b. Concrete Block: Use Class A(AE) concrete. Refer to Section 03055. Refer to Section 03211 for reinforcement bar requirement.

2.6 W-BEAM CURVED GUARDRAIL

A. All elements as per BA Series Standard Drawings.
   1. See plan set for radius requirements
   2. Shop bend all curves.
   3. Meet of this section for w-beam guardrail and anchor system.

4. Controlled Release Terminal Post (CRT) breakaway post: meet wood post and blocks requirements of this section.
   a. Drill two 3½ inch holes center of post, 29 inches and 45 inches from top of post.

2.7 W-BEAM NESTED GUARDRAIL

A. All elements as per BA Series Standard Drawings.
   1. W-Beam: meet requirements of this section
   2. CRT Post (breakaway post): meet wood post and blocks requirements of this section.
      a. Drill two 3½ inch holes center of post, 29 inches and 45 inches from top of post.

2.8 W-BEAM MEDIAN BARRIER

A. All elements as per BA Series Standard Drawings.
   1. Meet requirements of this section for W-Beam guardrail, posts, blocks, and hardware.

2.9 BARRIER DELINEATION

A. Sheeting: Refer to Section 02842.

B. Hardware: Refer to GW Series Standard Drawings.

PART 3 EXECUTION

3.1 TRAINING REQUIREMENT

A. Attend the Utah Department of Transportation 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. Supply Guardrail Training Certificate to the Engineer before beginning installation.

C. Have an installer who has attended one of the approved training courses on the job site at all times when guardrail or elements of a w-beam guardrail system are being installed.

3.2 PREPARATION

A. Site considerations:
   1. Complete grading requirements before installation of guardrail and crash cushions.
   2. 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.

3.3 POSTS AND BLOCKS

A. Drill all required holes in posts and blocks as per BA Series Standard Drawings before installation.
   1. Field drilling post is acceptable when installing the bottom rail.
      a. Coat all 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.

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 an average of at least 96 percent of maximum laboratory density and dispose of excess material. Refer to Section 02056.

3.4 RAIL ELEMENTS

A. Drill or punch all required holes as per BA Series Standard Drawings before installation. Acceptable
   1. Field drilled holes in rail element 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 all curved sections as required in BA Series Standard Drawings.

3.5 DELINEATION HARDWARE

A. Supply Barrier Reflectors: Refer to Section 02842 and GW Series Standard Drawings.

B. Attach Barrier Reflectors: Refer to BA Series Standard Drawings.

C. Application: Refer to GW Series Standard Drawings.

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

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 268: Retroreflective Sheeting for Traffic Control

C. ASTM A 1011: Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

D. ASTM D 638: Tensile Properties of Plastics

E. ASTM G 23: Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

F. Military Specification MIL-M 43719B

G. Standard Specifications for Construction of Road and Bridges on Federal Highway Projects, FP-92, Type III

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 lbs/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 1100 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, ± 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 ± 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 ± 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 following 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. Reflective sheeting: Encapsulated lens sheeting or encapsulated lens (flexible) as specified. Standard Specifications for Construction of Road and Bridges on Federal Highway Projects, FP-92, Type III. Refer to AASHTO M 268.

B. Non-reflective sheeting: As specified. Military Specification MIL-M 43719B, Type I, Class I.

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

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install crash cushions

B. Furnish and install crash cushion markings

1.2 RELATED SECTION

A. Section 02056: Embankment, Borrow, and Backfill

1.3 REFERENCES

A. ASTM D 4956: Standard Specification for Retroreflective Sheeting for Traffic Control

B. Energite® III Module Systems Design Manual

C. NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features

D. UDOT Guidelines for Crash Cushions and Barrier End Treatments, current edition

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Installer Certification.
   1. Manufacturer certified installer.
   2. Provide proof of certification prior to installation.

B. Provide a letter of certification for each system location affirming it is installed according to Department's and the manufacturer's specifications.
   1. Reference project number and describe station/location indicating median, left or right shoulder, or gore area application.

PART 2 PRODUCTS

2.1 CRASH CUSHION

A. Select from the current approved products list, UDOT Guidelines for Crash Cushions and Barrier End Treatments.
   1. Refer to the current UDOT Guidelines for Crash Cushions and Barrier End Treatments for specific uses and requirements for each approved system type. The UDOT Guidelines for Crash Cushion and Barrier End Treatments is maintained by the Division of Traffic and Safety and available through the UDOT Internet home page. Refer to http://www.udot.utah.gov/go/standardsreferences.
      a. Systems tested under NCHRP-350 requirements and a letter of acceptance issued by FHWA.
      b. Supply three sets of shop drawings and installation drawings for each system type supplied.
         1) Distribute drawings to Contractor, installation contractor, and Engineer or designated representative.
   2. Refer to CC Series Standard Drawings for each approved system type.

B. Types:
   1. Type A: Protects fixed hazards greater than 3 ft wide 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 specified in plan set.
      b. Supply system for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments, current edition.
      c. Galvanize all 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 1.2 times the required minimum clear zone.
         1) Two transition elements required when system is installed with w-beam median barrier.
      e. Install system on concrete pad according to manufacturer's requirements.
      f. Supply crash cushion markings. Refer to CC Series Standard Drawings.

2. Type B: Protects fixed hazards up to 3 ft wide or less 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 specified in plan set.
    b. Supply systems for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments, current edition.
    c. Galvanize all 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 1.2 times the required minimum clear zone.
        1) Two transition elements required when system is installed with w-beam median barrier.
    e. Install system on concrete pad according to manufacturer's requirements.
    f. Supply crash cushion markings. Refer to CC Series Standard Drawings.
3. Type C: Protects fixed objects 3 ft wide or less within 15 ft of traveled way, and longitudinal space in front of the hazard greater than 100 ft.
    a. Galvanize all 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.
    c. Supply crash cushion markings. Refer to CC Series Standard Drawings.
4. Type D: Protects fixed hazards within 15 ft of traveled way. Use in areas where one impact per year is anticipated or when repair history indicates two or more impacts over a three-year period.
    a. Supply system with an adequate width as specified in plan set.
    b. Supply system for the required speed according to UDOT Guidelines for Crash Cushions and Barrier End Treatments, current edition.
    c. Galvanize all 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 1.2 times the required minimum clear zone.
        1) Two transition elements required when system is installed with w-beam median barrier.

e. Install system on concrete pad according to manufacturer's requirements.
f. Supply crash cushion markings. Refer to CC Series Standard Drawings.

5. Type E - Sand Barrel Arrays: Protects fixed hazards outside of 15 ft from the traveled way and there is an unlimited amount of space. Refer to the UDOT Guidelines for Crash Cushion and Barrier End Treatments for specific uses and requirements of 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-redirective, 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 leakage of sand but allow for the 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, 1400 lb, and 2100 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. Use dry sand to fill modules, 2 percent or less moisture.
   f. Supply crash cushion markings and construct pad. Refer to CC Series Standard Drawings.

6. Type F: Use to protect concrete barrier or bridge parapets with less than 150 ft of longitudinal space in front of the hazard. Used in a unidirectional application.
   a. Galvanize all steel parts according to manufacturer's requirements.
   b. Install system on concrete pad when specified by manufacturer and to the manufacturer's specifications.
   c. Supply crash cushion markings. Refer to CC Series Standard Drawings.

7. Type G: Use to protect the approach end of single face w-beam guardrail or approach ends of bridge parapet and concrete barrier with unlimited longitudinal space (greater than 125 ft) in front of the hazard in a unidirectional application and install where a tangent system is desired. W-beam transition element is required when system is installed at the end of bridge parapet or the end of concrete barrier.
    a. Supply post option as described in UDOT Guidelines for Crash Cushion and Barrier End Treatments, current 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 all steel parts according to manufacturer's requirements.
    e. Supply crash cushion markings. Refer to CC Series Standard Drawings.
8. Type H: Use to protect the approach end of single face w-beam guardrail or approach end of bridge parapet and concrete barrier with unlimited longitudinal space (greater than 125 ft) in front of the hazard in a unidirectional application, and is installed where a flared system is desired. W-beam transition element is required when system is installed at the end of a bridge parapet or the end of concrete barrier.
    a. Supply post option as described in UDOT Guidelines for Crash Cushion and Barrier End Treatments current 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 all steel parts according to manufacturer's requirements.
    e. Supply crash cushion markings. Refer to CC Series Standard Drawings.

2.2 CRASH CUSHION MARKINGS

A. Marker plate: Refer to CC Series Standard Drawings.
    1. Construct marker plate 18 inches x 18 inches using 0.032-gage aluminum with appropriate object marker sheeting.
        a. Drill a $^{7}/_{16}$ inch hole in each corner of plate.
        b. Use ASTM D 4956 Type III sheeting with encapsulated glass bead retroreflective material, or greater. Use appropriate sheeting type for the substrate sheeting is placed on.

c. Use a 24 inch x 14 inch object marker plate or self-adhesive object marker sheeting ASTM D 4956 Type III sheeting with encapsulated glass bead retroreflective material or greater for Type C systems. Use appropriate sheeting type for the substrate sheeting is placed on.

d. Substitution of self-adhesive object marker sheeting ASTM D 4956 Type III sheeting with encapsulated glass bead retroreflective material or greater, 18 inches x 18 inches or 24 inches x 14 inches placed directly on system for Marker Plate is acceptable.

e. Accept object markers supplied by the manufacturer that exceed the above requirements.

B. Marker Post: Refer to CC Series Standard Drawings

1. Construct marker post, 60 inches long and 2 inches OD, using black polyethylene material.

a. Close top of marker post.

b. Drill three $^{7}/_{16}$ inch mounting holes.

c. Apply three 4-inch bands of yellow sheeting ASTM D 4956 Type III sheeting with encapsulated glass bead retroreflective material or greater.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prepare site to finished grade prior to installation of crash cushion or barrier end treatment.

1. Construct approach areas and recovery areas to meet UDOT Standards and system requirements prior to installation of system.

a. Refer to CC Series Standard Drawings for system requirements.

2. Construct concrete pad when applicable, to meet system requirements.

a. Use manufactures specification for concrete pad construction.

b. Refer to CC Series Standard Drawings for Type E - sand barrel detail, for pad requirements.

3. Obtain Engineer's approval of site grading, approach and recovery areas, and layout, prior to system installation.

4. Compact backfill material around posts and foundation tubes to minimum 96 percent of maximum laboratory density and dispose of excess material. Refer to Section 02056.

B. Install according to:
   1. 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. Complete repair or replacement of any crash cushion damaged during construction within 24 hours of notification of damage.
   1. Contractor is responsible for the cost of repair or replacement of any permanent system damaged for any reason until final acceptance.
      a. Exception:
         1) Damage is caused by an errant vehicle
         2) Damage occurs after Traffic has been established in the final lane configuration with shoulders as established in the project plans.
      b. 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 above apply.

END OF SECTION

SECTION 02844

CONCRETE BARRIER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precast concrete barriers: New Jersey shape, full, half, and terminal section.

B. Precast constant slope concrete barrier.

C. Cast-in-place concrete barriers.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02842: Delineators

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03390: Concrete Curing

F. Section 03392: Penetrating Concrete Sealer

1.3 REFERENCES

A. ASTM A 36: Carbon Structural Steel

B. ASTM A 325: Standard Specification for Structural Bolts

C. ANSI/AASHTO/AWS D1.5

D. 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.

2.2 STRUCTURAL STEEL

A. Connection pins, connection loops, and stabilization pins. Refer to ASTM A 36.

B. Connection Threaded Rod. Refer to ASTM A 325.

2.3 REINFORCING STEEL AND WELDED WIRE FABRIC

A. Refer to Section 03211. Refer to ANSI/AASHTO/AWS D 1.5.

2.4 BARRIER SEAL FOR ALL PRECAST CONCRETE BARRIER

A. Polyester polyurethane open-cell foam 100 percent impregnated with asphalt.

B. Foam unit weight requirements:
   1. Before impregnation: 68 lbs/yd^3 to 85 lbs/yd^3.
   2. After impregnation: 252 lbs/yd^3 to 270 lbs/yd^3.

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 specified reinforcing steel. Refer to Section 03211.

B. Hot and cold weather limitations. Refer to Section 03055.

2.6 PRECAST NEW JERSEY SHAPE SECTION AND CONSTANT SLOPE CONCRETE BARRIER

A. Pre-qualify the fabricator as a supplier of precast concrete products in accordance with the 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. Impress ¼ inch deep into the top center of the barrier.

C. Prevent cracking or damage during handling and storage of precast units. Replace cracked or damaged precast units at no additional cost to the Department.

D. Do not ship until:
   1. 28-day compressive strength acquired.
   2. Cured and sealed according to Section 03390.
   3. Visually inspected and accepted by the Engineer.

2.7 BARRIER DELINEATION

A. Sheeting: Refer to Section 02842.

B. Hardware: Refer to GW Series Standard Drawings.

2.8 SURFACE SEALING MATERIAL FOR ALL BARRIER TYPES

A. Refer to Section 03392.

2.9 EXTRUSION AND SLIP FORM MACHINES FOR CAST-IN-PLACE CONSTANT SLOPE BARRIER

A. 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.

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: Complete grading requirements and place any required paved surfaces. Refer to BA Series Standard Drawings before installing barrier. Complete grading requirements prior to installation of barrier or crash cushions. Refer to CC Series Standard Drawings.

B. For cast-in-place constant slope protection:
   1. Before applying curing compound, give the surface a final soft brush finish with strokes parallel to the line of barriers.
   2. Do not finish with a brush application of grout.
   3. Refer to Section 03392.
   4. Complete grading requirements prior to installation of crash cushions reference CC Series Standard Drawings.

3.2 PRECAST CONCRETE FULL BARRIER (NEW JERSEY SHAPE) AND CONSTANT SLOPE CONCRETE BARRIER

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. Tighten X-connection bolt until snug and then add one turn.

3.3 CAST-IN-PLACE CONSTANT SLOPE CONCRETE BARRIER

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 form joints before applying curing compound.

E. Curing: Refer to Section 03390.

F. Penetrating Concrete Sealer:
   1. Application rate based on resident content at a coverage rate of 0.11 lbs/yd^2.
   2. Apply according to the manufacturer's recommendation for horizontal, vertical, and all surfaces.
   3. Select a sealer with maximum drying time of 1½ hours.

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 02861

PRECAST RETAINING/NOISE WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing Precast Noise and Retaining/Noise Walls.

1.2 RELATED SECTIONS

A. Section 01571: Environmental Controls

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 02075: Geotextiles

D. Section 03055: Portland Cement Concrete

E. Section 03152: Concrete Joint Control

F. Section 03211: Reinforcing Steel and Welded Wire

G. Section 03310: Structural Concrete

H. Section 03390: Concrete Curing

I. Section 03392: Penetrating Concrete Sealer

J. Section 09981: Concrete Coating

1.3 REFERENCES

A. AASHTO LRFD Bridge Construction Specifications

B. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Lifting Devices: Submit calculations and shop drawings for approval.

B. Precast Concrete Panels: Submit for approval samples of the specified surface texture architectural treatments before casting the panels. Refer to the plans for the required surface texture architectural treatments.

C. Manufacturer's product data, specifications, and recommended wall installation instructions.

1.6 SHIPPING, HANDLING, AND STORAGE

A. Shipment Acceptance: Panels or posts may be accepted for shipment if they meeting the following requirements:
   1. 28 day compression test
   2. Cured and sealed according to specification
   3. Not cracked or damaged

B. Do not ship any panel or post that does not satisfy strength requirements.

PART 2 PRODUCTS

2.1 CONCRETE

A. Precast Panels and Posts:
   1. Concrete Class AA(AE). Refer to Section 03055.
      a. Slump requirement need not be met.
      b. 28-day minimum compressive strength of 5,000 psi.

B. Post Holes: Concrete Class B. Refer to Section 03055.

2.2 REINFORCING STEEL

A. Coated. Refer to Section 03211.

2.3 WELDED WIRE FABRIC

A. Coated. Refer to Section 03211.

2.4 FORM-LINER MATERIALS

A. Use a form-liner capable of producing uniform texture and patterns, and capable of releasing the sculpted concrete surface without damage.

B. Provide solid backing and form supports so that the form liners remain in place during concrete placement.

C. Form Release Agent:
   1. Use 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.
   2. Use a non-petroleum release agent meeting all EPA requirements.
   3. Use a release agent not detrimental to concrete strength or durability and that does not impart color, tint, or texture to the finished product.

2.5 CURING COMPOUND

A. Refer to Section 03390.

2.6 GRAVEL FOR POST HOLES

A. Use Free Draining Granular Backfill. Refer to Section 02056.

2.7 ELASTOMERIC BEARING PAD

A. As specified in AASHTO LRFD Bridge Construction Specifications, Article 18.2.

B. Use 60 hardness.

2.8 BACKER ROD

A. Refer to Section 03152.

2.9 CONSTRUCTION ADHESIVE

A. As recommended by the wall manufacturer.

2.10 WOOD SHIMS

A. Use any grade fir.

2.11 COMPOSITE DRAINAGE MATERIAL

A. Two-layer composite, consisting of non-woven silt fence geotextile and matting surface that are heat bonded together.
   1. Polyester non-woven fabric. Refer to Section 01571.
   2. Compression resistant matting of three-dimensional construction capable of multidirectional flow.

2.12 DRAINAGE GEOTEXTILE

A. Refer to Section 02075.

2.13 LIFTING DEVICES

A. Use the number, type and size necessary to lift the largest precast panel used on the project.

B. Use a galvanized flush-type that does not project beyond the edge of the panels.

C. Capable of lifting the maximum size of panel required and of tilting it from horizontal position to vertical position.

D. Shear factor of safety of 2.66:1 for lifting from a flat position and a tension factor of safety of 4:1 for lifting from a vertical position.

E. Designed for shear so that the panels can be lifted from either side.

F. Provide a sealing cover.

PART 3 EXECUTION

3.1 FABRICATION

A. Use a UDOT prequalified supplier of precast concrete products according to the UDOT Quality Management Plan: Precast/Prestressed Concrete Structures.

B. 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. Place markings in fresh concrete near the bottom of the post.
   3. The Department accepts posts if:
      a. They meet the 28-day compressive strength.
      b. They are cured and sealed according to specification. Refer to Sections 03390 and 03392.
      c. They have been visually inspected and accepted by the Engineer.
      d. They have sides that do not deviate from a straight line by more than ⅛ inch in 10 ft.

4. Replace posts that are:
   a. Cracked or damaged.
   b. Not permanently marked.

C. Precast Concrete Panels
1. Cast the panels to required tolerances regarding all dimensions.
   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 having smooth, solid surfaces free of voids and air pockets.
2. Permanently mark each panel with the date of casting and the panel identification number supplied by Engineer on the panel end near the top.
3. Provide the specified surface texture architectural treatment on both sides of noise panels. Provide the specified surface texture architectural treatment 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, which are uniform, straight and sharp.
4. The Department accepts panels when:
   a. They meet the 28 day compressive strength.
   b. They are cured and sealed according to specification. Refer to Section 03390 and 03392.
   c. They have been visually inspected and accepted by the Engineer.
   d. They have sides that do not deviate from a straight line by more than ⅛ inch in 10 ft.
5. Replace panels that:
   a. Are cracked or damaged.
   b. Do not match in contrast.
   c. Are not permanently marked.
   d. Show discoloration from release agents or curing 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. Limitations
   1. Refer to Section 03310 for hot and cold weather concrete limitations.

E. Curing
   1. Cure as specified in Section 03390.

3.2 DELIVERY, HANDLING, AND STORAGE

A. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, staining, and to prevent cracking, distortion, warping or 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.

3.3 POST HOLES

A. Refer to SW Series Standard Drawings.

B. Place edge of post holes no nearer than 2 ft from any underground utility.

3.4 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.

C. Replace cracked or damaged posts.

D. Attach elastomeric bearing pads to concrete posts using construction adhesive. Follow the manufacturer's recommendations.

3.5 PRECAST CONCRETE PANEL PLACEMENT

A. Set elevations in the field for the Engineer's acceptance. Stake elevations to the bottom of the bottom panel. Align as shown on the plans.

3.6 LIFTING DEVICES

A. Place waterproof caps in the lifting devices after the panels are permanently placed.

3.7 RETAINING WALLS

A. Follow SW Series Standard Drawings.

B. Composite drainage material:
   1. Place behind the retaining panels at each weep hole location.
   2. Place the fabric side of the material against the fill. Extend the length of the material from the bottom of the retaining panel to the top of the fill.
   3. Attach to panels using construction adhesive. Follow manufacturer's recommendations.

C. Drainage Geotextile: Place around the back side of the posts as shown in the drawings. Extend the material from the bottom of the retaining panel to the top of the fill. Attach to posts using construction adhesive. Follow manufacturer's recommendations.

D. Free Draining Granular Backfill: Place and tamp down behind the retaining panels, between the posts to the fill height and length, and at the locations shown on the plans.

3.8 CONCRETE STAINING

A. Stain concrete surfaces of posts and panels after installation is complete and as specified on the plans. Refer to Section 09981.

B. Stain concrete surfaces to 6 inches below the finished ground line.

END OF SECTION

SECTION 02891

TRAFFIC SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing traffic signs.

1.2 RELATED SECTIONS

A. Section 02317: Structural Excavation

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 05120: Structural Steel

1.3 REFERENCES

A. ASTM A 513: Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

B. ASTM A 653: Steel, Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by Hot-Dip Process

C. ASTM B 209: Aluminum and Aluminum-Alloy Sheet and Plate

D. American Plywood Association (APA) Product Standard

E. Code of Federal Regulations (CFR)

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.
      b. Legend:
         1) 1: With non-reflective legend, symbols, and borders.
         2) 2: With 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: 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. 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. All components and warranties will be compatible with substrates used by UDOT, including 90/90 HDO plywood and 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: Height x Width
8. Substrate: The base material, usually plywood or aluminum, to which the background sheeting is attached.

1.5 SUBMITTALS

A. Submit three sets of drawings for overhead structures for prefabrication approval. Allow 14 calendar days for approval.

B. Manufacturer's Product Data and Specifications.

1.6 SIGN CODES

A. New Sign: N

B. Relocation: R

C. Removal: X

D. Panel Replacement: PR

E. Panel Overlay: PO

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabricate signs and posts according to SN Series Standard Drawings.

B. Substrate Aluminum: 0.080 inch thick. ASTM B 209 alloy 6061-T6, or 5052-H38.

C. Substrate Plywood: as specified below and which meets the APA product standard 1 PSI-83, Group 1, ⅝ inch thick.
   1. 90/90, high density BB exterior (Douglas Fir) B Grade.
   2. Plugged-core (Douglas Fir) with ½ inch maximum gaps.
   3. Use acrylic laminate that is compatible with the retroreflective sheeting adhesive, and that does not require the removal of the release agents before applying the sheeting.

D. Bases: according to SN Series Standard Drawings
   1. Small Sign Tubular Steel Sign Base (B1)
      a. Manufactured according to Standard Drawings.
      b. Concrete foundation according to Standard Drawings.
   2. Small Sign Tubular Steel Sign Base (B2A)
      a. Manufactured according to Standard Drawings.
   3. Small Sign Tubular Steel Post Base (B2B)
      a. Manufactured according to Standard Drawings.
      b. Concrete foundation according to Standard Drawings.
   4. Slipbase Tubular Steel Sign Base (B3)
      a. Manufactured according to Standard Drawings.
         1) SLB-1 Slipbase top casting with locking ring.
         2) SLB-2 Slipbase top casting with set screws.
      b. Concrete foundation according to Standard Drawings.
   5. Slipbase Tubular Steel Sign Base Surface Mounted (B4A)
   6. Tubular Steel Sign Base Surface Mounted (B4B)
   7. Slipbase Tubular Steel Sign Base Barrier Mounted (B5)
   8. Freeway Sign Base
      a. Pipe Posts (B6A)
         1) Match base size with post size
      b. S Section post (B6B)
         1) Match base size with post size
      c. W Section post (B6C)
         1) Match base size with post size
      d. Concrete foundations according to Standard Drawings.

E. Posts, “T” and “U” brackets, extensions, and hardware: according to SN Series Standard Drawings.
   1. Post P1:
      a. 2⅜ inch outside diameter 0.080 (14 Gauge)
      b. ASTM A 513
      c. Galvanize to ASTM A 653
      d. Color: Powder coated as required
   2. Post P2:
      a. 2⅜ inch outside diameter 0.095 (13 Gauge)
      b. ASTM A 513
      c. Galvanize to ASTM A 653
      d. Color: Powder coated as required
   3. Post P3:
      a. 2⅞ inch outside diameter 0.134 (BWG 10)
      b. ASTM A 513
      c. Galvanize to ASTM A 653
      d. Color: Powder coated as required
   4. Post P4:
      a. 2⅞ inch outside diameter 0.160 (NP 40)
      b. ASTM A 513
      c. Galvanize to ASTM A 653
   5. Post P5:
      a. 2⅞ inch outside diameter 0.276 (SCH 80)
      b. ASTM 500
      c. Galvanize to ASTM A-123
   6. “T” and “U”, Extension and 90˚ Post Extension
      a. Manufacture according to Standard Drawings.
      b. Galvanize each
   7. Standard Pipe Posts
      a. Match post size with base requirements.
   8. S Section and W Section steel posts
      a. Structural Steel: Refer to Section 05120.
      b. Match post size with base requirements

F. 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 or exceed the minimum requirements of ASTM Type IX.

G. Non-reflective Sheeting: As specified and in accordance with the recommendation of the retroreflective sheeting manufacturer.

H. Fasteners: As required on applicable SN Series Standard Drawings

I. Foundation: as required on applicable SN Series Standard Drawings
   1. Concrete: Class AA(AE). Refer to Section 03055.
   2. Reinforcing steel: Refer to Section 03211.
   3. Anchor bolts: Refer to Section 05120.

J. Structural Steel: Structural Steel frame. Refer to Section 05120.

K. Temporary covering: Opaque material.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility location.

B. Excavate: Refer to Section 02317.

C. Install traffic control devices before work activities begin.

3.2 INSTALLATION – GENERAL

A. Do not reverse screen sign larger than 7 ft^2/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.

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. Maintain covering until covering or sign is removed.

F. Construct sign post foundations with concrete conforming to indicated dimensions.

3.3 RELOCATE EXISTING SIGN

A. Retrofit as required to meet current standards.

B. Provide new posts and accessories as required.

C. Remove foundations to a minimum of 6 inches below the ground line and backfill.

3.4 REMOVE EXISTING SIGN

A. Remove foundations to a minimum of 6 inches below the ground line and backfill.

END OF SECTION

SECTION 02892

TRAFFIC SIGNAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing traffic signals.

B. Materials and procedures for installing traffic counting loop detectors.

1.2 RELATED SECTIONS

A. Section 02466: Drilled Shafts

B. Section 02741: Hot Mix Asphalt (HMA)

C. Section 02748: Prime Coat/Tack Coat

D. Section 02891: Traffic Signs

E. Section 03055: Portland Cement Concrete

F. Section 03211: Reinforcing Steel and Welded Wire

G. Section 03310: Structural Concrete

H. Section 03575: Flowable Fill

1.3 REFERENCES

A. ASTM A 123: 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 A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

D. ASTM A 570: Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

E. ASTM B 85: Aluminum-Alloy Die Castings

F. ASTM B 766: Electrodeposited Coatings of Cadmium

G. ASTM D 638: Tensile Properties of Plastic

H. ASTM D 2240: Rubber Property-Durometer Hardness

I. ASTM D 3005: Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

J. ASTM F 1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

K. American Iron and Steel Institute (AISI)

L. American National Standards Institute (ANSI)

M. American Wire Gauge (AWG)

N. Electric Utility Service Equipment Requirements Committee (EUSERC)

O. International Municipal Signal Association (IMSA) Standards

P. National Electrical Code (NEC)

Q. National Electrical Manufacturers Association (NEMA)

R. Pedestrian Traffic Control Signal Indicator (PTCSI) Standards

S. Rural Electrical Association (REA) Bulletin

T. Underwriters Laboratory (UL)

U. Vehicle Traffic Control Signal Head (VTCSH) Standards

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Certified test report of wire compliance as specified. IMSA 20-1, 50-2, 51-1, 51-3, 51-5, 51-7, 60-6.

B. Submit samples of materials for approval when requested.

C. Submit two copies of the following within 15 days after receiving notice to proceed:
   1. List of equipment and materials–name of manufacturer, size, and identification number.
   2. Detailed shop drawing, wiring diagrams, and certifications.
   3. Manufacturers' warranties, guarantees, instruction sheets, and parts lists.

D. Submit UDOT Vehicle Detector and Street Lighting Splice certifications for all individuals that will perform wiring splices.

1.6 ACCEPTANCE

A. Signal Warranties and Guarantees
   1. The notice of acceptance for traffic signal work is not given until six months after the date of completion of punch list items.
   2. During this period, all manufacturer's warranties and guarantees on Contractor-furnished electrical and mechanical equipment are enforced.
   3. At the end of the period and after all electrical and mechanical defects within the scope of warranties and guarantees are corrected, the Engineer makes written acceptance of the work completed and relieves the Contractor of further responsibility for that portion of the project.
   4. Partial acceptance does not void or alter any terms of the contract.

B. The six-month warranty period for signal work does not affect the processing of a semi-final estimate when the contract is 95 percent or more complete or after completion of work on the project.

C. 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 1

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. Minimum acceptable reading measured between the loop conductor and ground is 450 MΩ or greater, when tested with a 500 V megohm meter.
5. Measure and report the inductance of each loop. Acceptable inductance readings are greater than 90 μH for individual loops, and less than 1,000 μH for a 4 loop group.

D. Signal Power Circuits:
1. Measure and report continuity of bonding conductors by testing between AC+ supply and metal poles: A 1,000 Watt load, tested to each pole frame must incur less than 2 Volts drop, measured from the pole to the cabinet neutral conductor.
2. Insulation resistance of supply conductors measured to ground will have not less than 100 MΩ of leakage (500 V megohm meter).

E. Video Detection Circuit: Demonstrate each video detection circuit operates per manufacturer's specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use electrical components as listed and defined by the NEC.

2.2 SIGNAL POLE AND TRAFFIC SIGNAL LIGHT SUPPORT ARM

A. Post Mounted Signals Pole:
   1. Steel, as specified. ASTM A 570, Grade 33.
      Allowable stresses: F_b = 21,750 psi (0.66F_y)
      F_V = 10,900 psi (0.33 F_y)
   2. Galvanized as specified. ASTM A 123.
   3. Wind load: 80 mph wind with 105 mph gusts.

B. Foundation:
   1. Concrete: Class AA(AE) Concrete. Refer to Section 03055.
   2. Reinforcing steel: Coated steel. Refer to Section 03211.

2.3 BOLTS, NUTS, AND HARDWARE

A. Anchor Bolts and Nuts:
   1. Steel as specified. Signal, CCTV, and Luminaire Poles use ASTM F 1554 Grade 55; Signal Cabinet use ASTM A 307.
   2. Zinc-plated or galvanized, as specified.
      a. Zinc-plated as specified. ASTM B 766.
      b. Galvanized steel: ASTM A 123.
   3. Nuts: Free running by hand for total thread length of bolt.

B. Slip Bolts as specified.
   1. Zinc plated: ASTM B 766.
   2. Steel: ASTM A 325.

2.4 WIRE

A. Copper, as specified. International Municipal Signal Association (IMSA)

B. Size as specified. AWG

C. Service Cable:
   1. Single-conductor, as specified. Types RHH-USE-RHW.

D. Interconnect cable:
   1. Twisted pair filled shielded cable, as specified. IMSA 60-6.
   2. Single mode fiber optic cable, as specified.

E. Signal Cable:
   1. Multi-colored cables, as specified. IMSA 20-1

F. Bonding/Grounding System Wire:
   1. Solid, bare, soft-drawn, copper wire, as specified. Sized to meet NEC 250-1.

G. Detector Lead-In Wire (homerun): as specified. IMSA 50-2.

H. Detector Loop Wire:
   1. PVC Sensor Loop Wire – No. 14, single-conductor, stranded wire as specified. IMSA 51-3.
   2. Saw Cut Sensor Loop Wire – No. 14, single-conductor, stranded wire encased in a polyethylene tube as specified. IMSA 51-7.

I. Commercially Manufactured Preformed Loop:
   1. Highly abrasion-resistant alloy cover with high tensile strength braided synthetic fiber reinforcement, max. O.D. of ⅜ inch.
   2. Withstand minimum pressure of 1400 psi.
   3. Good flexibility over a wide temperature range and rated to withstand the temperatures of an asphalt overlay project.
   4. Superior resistance to oil, gasoline, salt, moisture and impact.
   5. Loops shall be individually marked as to the direction of the wire turns.
   6. Manufacturer to provide minimum 15 year guarantee.

J. Splice Sealing: Rural Electrical Association (REA) Bulletin 17551-100.
   1. Insulate conductors individually and encapsulate with mastic rubber pads and over wrap with vinyl electric tape. Overcoat completed splice with waterproof sealant. ASTM D 3005, Type I or II. UL 510.

K. Color Coding Tape:
   1. Vinyl electric tape, as specified. UL 510.

L. Video Detection Circuit:
   1. Video Detection/Camera Power Circuit Cable: As specified per manufacturer requirements.

2.5 VEHICLE TRAFFIC SIGNAL HEAD

A. Comply with VTCSH standards. Refer to SL Series Standard Drawings.

B. Signal Head Assembly:
   1. 12-inch vehicular signal head as specified.
   2. Separate, interchangeable, and expandable without tie rods.
   3. Stainless steel bolts, screws, hinge pins, lugs, and hardware.

4. Die-cast aluminum parts, including the doors, as specified: ASTM B 85. Clean, smooth parts free from flaws, cracks, blowholes, or other imperfections.
5. Perimeter door gasket to provide moisture and dust resistant seal.
6. Mounting hardware for securing LED module to door housing.
7. Integrally round serrated boss openings in the top and bottom of each section that accepts a standard 1½ inch pipe mounting or universal bracket mounting hardware. Capable of adjusting a full 360 degrees around a vertical axis.
8. 6-position wiring terminal strip.
9. Tunnel visor securely mounted to the door at a minimum of four attachment points.
10. Powder coat all exterior and interior surfaces of the signal housing, door, and outside of visor in Highway Yellow. Inside of visor is painted flat black.

C. Optical Unit:
1. Mount LED Ball and Arrow Vehicle Signal Module to door housing for unrestricted easy access.

D. Back Plate:
1. Constructed with minimum 18-gage aluminum.
2. Provide louvered design to reduce wind loading on mast arm structure.
3. Both sides primed and painted flat black.
4. Designed to be attached to the signal head used.

2.6 PEDESTRIAN SIGNAL HEAD

A. Comply with PTCSI standards. Refer to SL Series Standard Drawings.

B. Signal Head Assembly:
1. Provide 16-inch by 18-inch housing, swing down door assembly, and LED module.
2. Moisture and dust resistant.
3. Die cast, single piece aluminum with 1½ inch top and bottom openings, and integrally cast shurlock boss. Use stainless steel screws and assembly hardware.
4. Swing down door assembly capable of being opened without tools, constructed from single piece aluminum alloy, die cast with two hinge lugs at the bottom and two latch slots at the top of the door. Universal housing with interchangeable castings for hinge and latch hardware is acceptable.
5. Three position wiring terminal strip.

6. Provide electrostatic apply synthetic enamel as specified. Gloss black case and doorframe. Oven-cure finish for a minimum of 20 minutes at 350 degrees F.

C. Optical Unit:
   1. Mount LED Pedestrian Signal and Count Down Pedestrian Signal Modules to door housing for unrestricted easy access.

2.7 PEDESTRIAN BUTTONS

A. Refer to SL Series Standard Drawings.

B. Pedestrian Button with LED Indicator
   1. Provide pedestrian button with standard 4-bolt circle (2.60-inch ± 0.05-inch diameter).
   2. Provide ADA compliant assembly with a 2 inch diameter stainless steel actuator, rated for 100 million actuations, requiring between 1 and 3 lb of force to actuate.
   3. Provide a low-movement (maximum movement of $^{12}/_{1000}$ of an inch), pressure activated, tamper-proof, highly vandal resistant button.
   4. Provide assembly with solid state electronic Piezo switch rated for 100 million cycles with no moving plunger or moving electrical contacts.
   5. Provide assembly with internal circuitry with a resetting switch so as to avoid held calls to the signal controller.
   6. Provide assembly with built in surge protection, with all switch electronics sealed within the cast aluminum housing. Enclose all supporting circuitry within the button with wiring to the pushbutton terminated on two screw terminals.
   7. Provide a rain-tight gasket to seal between the button assembly and the frame.
   8. Provide assembly that is designed to prevent water and ice from entering or accumulating on or in the button, and that is capable of protecting the button cap from side impacts.
   9. Provide button that gives feedback 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 stays on for 3-5 seconds if the button is pushed and held closed.

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 ¼ inch 20 x 1½ inch hex head brass bolts attached behind the sign.
   b. Frame is additionally supported using adjustable staves.
   c. Sign attaches above the button using 8-32 stainless steel Allen-head screws.
   d. Cable guide extends through a ⅞ inch diameter mounting hole in the support pole to channel wiring to the button.

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 a two-sided R10-4b sign, with one side of the sign with a right arrow and the other side of the sign with a left arrow.
3. Provide sign fabricated from aluminum substrate using ASTM Type III or higher reflective sheeting (sign Type A1) with standard 8-32 clearance holes or eyelets for mounting.

2.8 LED SIGNAL MODULES

A. LED Signal Module Standards:

1. Use new LED vehicle signal modules that meet current VTCSH standards.
2. Use new LED pedestrian and countdown signal modules that meet current PTCSI standards.

B. Physical Requirements:

1. Use modules that fit into traffic signal housing without modification to the housing.
2. Use retrofit replacement modules that only require removal of the existing optical unit components, i.e., lens, lamp module, gaskets, and reflector.
3. Watertight and dust resistant module that securely fits the housing door and wire pigtails for direct connection to wiring terminal strip. Screw-in modules are not acceptable.
4. Provide tinted lens for all LED modules.
5. Use LED modules that have the appearance of an incandescent traffic signal lens and wide angle viewing capability.

C. Additional Requirements for Pedestrian Signal Modules:

1. Provide 9-inch countdown numerals when specified.
2. Provide symbol message that blanks out under ambient light conditions when the pedestrian symbols are not active.

3. Provide circuitry that isolates man/hand symbols so they cannot be displayed at the same time.

D. Manufacturer Warranty:
1. Provide the following minimum warranty provisions:
a. Replace or repair module if it fails to function as intended due to workmanship or material defects within the first 84 months from the date of delivery. The warranty covers all parts and labor necessary or incidental to the repair.
b. Provide all guarantees that are customarily issued by the Bidder or manufacturer to the State of Utah.
c. UDOT or its appointee may elect to make minor repairs, with the consent of the manufacturer. Make all other repairs under warranty by the manufacturer. The manufacturer bears all costs including labor, parts, and shipping charges.
d. Replace or repair all LED Vehicle Traffic Signal Modules that exhibit luminous intensities less than the minimum values specified in Article H-1a within the first 60 months of the date of delivery.

2.9 ELECTRICAL CONDUIT

A. Conduit and fittings:
1. Schedule 40 PVC rated at 190 degrees F as specified. NEMA TC-2, TC-3. UL Listed.
2. Rigid steel as specified. UL 6.
3. Galvanized as specified. ANSI C80.1.

B. Steel Casing:
1. Provide smooth steel casing with a minimum ¼ inch wall thickness and diameter as specified.

2.10 VEHICLE DETECTION

A. Refer to SL Series Standard Drawings.

B. Video Detection:
1. State-furnished video detection equipment as specified. Contact the Engineer for approved manufacturers and products.

C. Induction Loop Detection:
1. PVC or preformed loops:
a. Use for presence detection, traffic queue detection, and dilemma zone detection.

2. Saw Cut loops:
   a. Use for presence detection, traffic queue detection, and dilemma zone detection.
   b. Use circular loop saw or standard pavement saw. Square loops require corner cuts. Avoid saw angles greater than 45 degrees.

D. Radar Detection:
   1. Use for dilemma zone detection for typical high-speed approaches, and advance signal warning systems.
   2. Use for vehicle counting.

2.11 LOOP SEALANT

A. Refer to SL Series Standard Drawings.

B. Traffic loop embedding sealant:
   1. Isophthalic, acid-based, unsaturated, polyester resin.
   2. With sufficient adhesion, strength, and flexibility to:
      a. Withstand normal movement in asphaltic and concrete pavements
      b. Protect the loop wire from moisture penetration, fracture and shear.
   3. Cured sealant resistant to motor oils, gasoline, anti-freeze solution, brake fluid, and de-icing chemicals.
   4. Meet the physical property requirements in Table 2.

Table 2

Traffic Loop Embedding Sealant		
Physical Properties	**Test**	
Shore D Hardness	ASTM D 2240	50-65
Specific Gravity		1.13 - 1.20
Styrene Monomer, percent		28 - 32
Viscosity: Pa·s	Brookfield Model LVF #3 Spindle @ 60 rpm	0.7-0.9
Gel Time	MEK Peroxide	11 - 15 minutes
Tensile Elongation, % @ Break	46-709	15 minimum
Pot life, minimum	ASTM D 638	5 minutes
Tensile Strength	ASTM D 638	1200 psi

2.12 LUMINAIRE

A. General:
   1. Die-cast aluminum housing.
   2. Reflectors, sockets, mounting cradles, and clamps fitted to the upper housing.
   3. High temperature wiring.
   4. Luminaire weight and projected area within design loading limits.
   5. Refer to SL Series Standard Drawings.

B. Ballast Assembly:
   1. Pre-wired on integral ballast with quick disconnect plugs mounted on a removable, hinged door.
   2. Multi-volt, multi-watt ballast.
   3. Provide correct ballast assembly for the specified lamp type:
      a. High-pressure sodium.
      b. Metal halide.

C. Optical Assembly:
   1. Formed aluminum reflectors with a chemically bonded, non-breakable, glass finish on both the inside and outside surfaces.

D. Mogul Base Socket:
   1. Adjustable with split-shell, tempered-brass lamp grips.
   2. Free-floating, spring loaded center contacts.
   3. Heat and impact-resistant glass prismatic refractors.

E. Mounting Adjustment:
   1. Standard Highway Luminaire (Cobra Head):
      a. Ten degrees above horizontal for the reflector and refractor.
      b. Five degrees adjustment from vertical on the bracket arm.

F. Lamp:
   1. High pressure sodium lamp as specified:
      a. Clear uncoated lamp.
      b. Apparent color temperature of 2100 K.
      c. Rated-life of not less than 24,000 hours when used on a 10 hour per start duty cycle.
   2. Metal halide lamp as specified:
      a. Clear uncoated, pulse start lamp.
      b. Apparent color temperature of 3800 K.
      c. Rated-life of not less than 20,000 hours (400 Watt) or 10,000 hours (250 Watt) when used on a 10 hour per start duty cycle.

2.13 GROUND ROD

A. Copper-coated steel as specified.

B. ANSI/UL 467.

2.14 MESSENGER CABLE

A. Use ⅜ inch diameter galvanized, stranded steel cable.

B. Minimum breaking strength of 10,800 lb as specified.

C. ASTM A 123.

2.15 MOUNTING BANDS AND BUCKLES

A. As specified.

B. AISI Type 201.

2.16 POWER SOURCE

A. Refer to SL Series Standard Drawings.

B. Pole Mounted Service:
   1. NEMA wet service rated service enclosure.
   2. Provide a manual EUSERC approved circuit closing link by-pass release meter socket.
   3. Other requirements as specified and as required by the local power company. Provide a product consistent with specifications for Underground Service Pedestal.

C. 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 MCM 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.

e. Provide one double pole 70-amp main circuit breaker labeled "Metered Main" and one single pole 40-amp circuit breaker labeled "Traffic Signal" with minimum capacity for four metered single pole circuit breakers. Provide traffic signal circuit breaker that is secondary to the metered main breaker.

f. 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. 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. Provide provisions for terminating to a ground rod.
3. Provide pedestal with UL 508 rating.
4. 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 rustproof.
   b. Provide exterior that has no exposed hardware except for handles.
5. Meet EUSERC requirements for all mounting hardware and installation details. Fit with EUSERC approved power meter base with manual link bypass.
6. Provide pedestal with service entrance, meter and distribution compartments with a corrosion resistant barrier to separate each compartment. Provide access panel or door with stainless steel piano hinges.
7. Provide cabinet with sealed windows of shatter resistant Lexan or equivalent. Provide a meter that can be read from the front of the cabinet.
8. 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.
9. Provide labels that are permanently etched or engraved and mechanically fastened to the cabinet. Label the front exterior of the cabinet "UDOT SIGNAL AND LIGHTING DISCONNECT."

2.17 FLOWABLE FILL

A. Refer to Section 03575.

2.18 HOT MIX ASPHALT

A. Half-inch nominal. Refer to Section 02741.

2.19 MAST ARM SIGNS

A. Provide sign fabricated from aluminum with Type III High Intensity sheeting (minimum). Refer to Section 02891.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the NEC.

B. Coordinate State Furnished Materials:
   1. Pick up at the Department's Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse to schedule a pickup.
   2. Pick up drop shipment materials at location specified.

C. Do not disconnect or remove an existing signal system until the replacement system is functioning.

D. Contact power company at least 30 days before the connection date, and verify the exact location, voltage, procedure, and materials required by the power company.

E. Pothole, locate, and expose any utility that will conflict with drilling, trenching, or boring work associated with placement of signal/pedestrian poles and conduit.

F. Reuse materials only as specified or as approved by the Engineer.

3.2 CONSTRUCT POLE FOUNDATION

A. Refer to SL Series Standard Drawings.

B. Concrete: AA(AE) required. Refer to Section 03055.

C. Structural Concrete: Refer to Section 03310.

D. Reinforcing Steel and Welded Wire: Refer to Section 03211.

E. Do not weld reinforcing steel, anchor bolts, or conduit.
   1. Use tie wire to secure conduit.
   2. Use template to align and secure anchor bolts.

F. Drilled Shafts: Refer to Section 02466. Place concrete directly in excavation. Use minimum forming above ground.

3.3 STEEL PLACEMENT

A. Install poles plum (vertically straight).

B. Tighten anchor bolt nuts on signal poles to snug-tight plus ⅓ turn.

C. Tighten anchor bolt nuts as shown on SL Series Standard Drawings for poles with break-away slip base systems.

D. Field assemble two-piece mast arm slip joint to achieve a snug fit. Apply anti-seize compound and provide overlap not less than 1½ times inside diameter of end section.

3.4 TRENCHING AND DIRECTIONAL BORING FOR CONDUIT

A. Trenching Paved Surface (asphalt concrete):
   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.
   4. Evenly apply tack coat before final backfill.
   5. Match the composition, density, and elevation (± $^{3}/_{16}$ inch) of the existing surface in the final 3 inches of backfill.

B. Trenching Unpaved Surface:
   1. Use backfill that matches the composition, density, and elevation (±$^{3}/_{16}$-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. Entirely replace any damaged section at no additional cost to Department.
   3. Dispose of surplus material daily.

C. Trenching under Railroad:
   1. As specified in railroad agreement.

D. Minimum cover of conduit:
   1. Minimum cover for all roadway crossings: 24-inches for conduit placed in trench; and 36-inches for directional bore conduit.

2. Minimum cover off roadway without concrete encasement or capping: 18-inches.
3. Minimum cover off roadway with concrete encasement or capping with minimum thickness of 2-inches: 12-inches.

E. Directional Boring:
1. Directional boring is an approved alternative to trenching unless otherwise specified.

3.5 INSTALL CONDUIT

A. Place all conduits in the same trench before surfacing.

B. Use galvanized rigid steel conduit above ground. Use PVC conduit under ground.

C. Seal uncapped conduit ends inside junction box with at least 2-inches of duct caulking or PVC cap.

D. Install No. 14 AWG single conductor copper, type THHN pull wire in all unused/future-use conduit.
1. On each end of conduit install cap with $^{7}/_{32}$ inch hole for pull wire.
2. Leave 20 inches of wire outside of the cap and fastened securely.
3. Place future-use conduit in top portion of junction boxes for future access.

E. Secure conduit on structures with standard galvanized iron conduit clamps using at least $^{5}/_{16}$ inch diameter concrete expansion anchors at maximum 60-inch spacing.

F. Use conduit expansion fittings at structure expansion joint crossings.

3.6 INSTALL WIRING

A. Conductors:
1. Clean and dry the inside of the conduit before installing conductors.
2. Install grounding conductor in all power circuit conduits.
3. Use powered soapstone, talc or other approved lubricants when pulling conductors in conduit.
4. Tape the ends of unused conductors and label them as spares.
5. Use conductors that are color coded as specified. See table 4. Meet IMSA 20-1.

B. Bonding Conductor (Ground) Wire:
1. Size bonding wire in conformance to NEC article 250. Run continuously and bond to each metal signal pole.

2. Bond the grounding system conductor to the ground rod in each junction box except in circuits with less than 50 V.

C. Arrange the wiring neatly within cabinets, junction boxes, fixtures, etc.

D. Terminate all terminal connections by a mechanical (spade) connector.

E. Loop Detection Wire Splicing:

1. Permit cable splices only in detection circuits where the wire type changes in the junction boxes. No other splices are allowed.
   a. Strip insulation back on the ends of the shielded cable wires and all of the loop wires that are to be joined in series to allow a non-insulated butt splice to be crimped onto them with a ⅛ inch of copper extending past the end of the butt splice.
   b. Strip loop ends as needed. Strip home run cable as needed and cut off the bare conductor drain wire. Use non-insulated butt splice connectors and crimp the loop leads to the home run leads then solder these connections.
   c. Use an electric or butane soldering iron to solder the splices when all pairs have been joined as specified above so that solder covers the splice inside and out. Do not melt the insulation.
   d. Wrap each soldered connection with black tape and mastic tape so that the non-insulated butt splices will not short circuit. Wrap entire splice with mastic tape then wrap the entire splice area with black tape. Be sure to overlap the outer sheaths on the home run and the loop leads by 1-inch. Apply waterproof sealant over the black tape and let dry.
   e. Use a nylon tie wrap to secure the loop leads at the best location possible inside the pull box. Provide loop leads that are at least 48-inches long as measured from the top of the pull box to allow the Contractor to work on the splice above the box.

F. Mark cabinet cables with colored vinyl electrical tape as specified in Table 3. Meet UL 510.

Table 3

Cables Marked with Colored Tape				
	Northbound P2	**Southbound P3**	**Eastbound P4**	**Westbound P1**
Signal Circuit	Blue	Red	Yellow	Orange
Detector Circuit	Blue	Red	Yellow	Orange
	Circuit Coding One band = Through, Two bands = Left Turn, Three bands = Queue, Four bands = Dilemma			
Pedestrian Head Circuit	Blue and Green	Red and Green	Yellow and Green	Orange and Green
Pedestrian Button Circuit (3)	Blue and White	Red and White	Yellow and White	Orange and White

G. Connect conductors according to Table 4.

Table 4

Color-Coded Conductors		
	North-South	**East-West**
Seven-Conductor Pedestrian Circuit	Red – Don't Walk Green -Walk White – Neutral	Black - Spare Orange – Don't Walk Blue - Walk White with Black Tracer - Neutral
Four -Conductor Pedestrian Head Circuit Push Button Circuit	Red – Pedestrian Call White - Common	Black - Pedestrian Call White - Common
Seven-Conductor Signal Circuit	White – Neutral Red - Red Through Orange - Yellow Through Green - Green Through Blue - Green Arrow White with Black Tracer - Yellow Left Black - Left red or spare	

3.7 INSTALL DETECTOR LOOPS

A. Refer to SL Series Standard Drawings.

B. One turn is once around the perimeter of the loop with the same conductor.
   1. Use number of turns as specified in Table 1 (Loop Resistance Table).
   2. Do not allow twists in the loop.
   3. No splices are allowed in loop

C. Loop lead-in from loop to junction box:
   1. Minimum of 3 twists per foot in saw cut.
   2. Minimum of 6 twists per foot inside of conduit.
   3. Do not interweave with other loop lead-ins.
   4. Each lead-in requires a separate conduit.

D. Carry shield continuity across all splices in Detector Lead-in (feeder) from the junction box to controller cabinet.

E. Saw cut loop:
   1. Only circular loops may be saw cut into existing surfaces.
   2. Remove all loose material and wash and dry all saw cuts.
   3. Place all loop wire in a ¼ inch polyethylene tube.
   4. Seat the conductor with no damage at the bottom of the slot. Place 1 inch backer rod pieces 18 inches along saw slot to prevent loop wires from floating upward in sealant.
   5. Fill the saw cut with embedding sealant. Surround the polyethylene tube to the level of the existing roadway surface. Remove any excess embedding sealant.

F. Preformed loop:
   1. Trench 6-inch maximum width with 6 inch minimum to 12 inch maximum cover in order to place loops below the pavement section.
   2. Include an additional turn in loops that are more than 8 inches below finished surface to compensate for reduced sensitivity.
   3. Anchor sensor loops to prevent movement or floating.
   4. Apply a tack coat to the sides and the bottom of trench and backfill with hot mix asphalt, ½ inch nominal aggregate mix for loops trenched under existing asphalt. Refer to Sections 02741 and 02748. Compact with flat nose jack hammer in 3 inch maximum lifts.
   5. Preform and place loops under new pavement 1¾ inches below the surface of the base course and backfill with surrounding material.

3.8 INSTALL POWER SOURCE

A. Verify the exact location, voltage, procedure, and materials required by the power company.

B. Refer to SL Series Standard Drawings.

3.9 INSTALL LUMINAIRE

A. As specified.

B. Refer to SL Series Standard Drawings.

3.10 INSTALL SIGNAL HEAD

A. Refer to SL Series Standard Drawings.

B. Do not install signal heads at the intersection until ready for operation.

C. Completely cover the vehicle signal heads with orange non-transparent, plastic garbage bags tied securely around the signal head if turn on is not immediate. New signal heads must not block active existing signals prior to new signal turn on.

D. Install optically-programmed signal heads in accordance with the manufacturers instructions.

E. Use louvered back plates on all signal heads except Type V.

F. Use cable straps for all universal signal mounts.

3.11 INSTALL MAST ARM SIGNS

A. Attach mast arm sign with mounting brackets using stainless steel straps. Do not drill holes in poles except as shown on the plans.

B. Mount sign on mast arm so that the legend/message is horizontal even if on a curved section of mast arm.

3.12 REMOVE AND SALVAGE EXISTING EQUIPMENT

A. Light poles, signal poles, messenger cable, signal and pedestrian heads, controller cabinets, other items as specified on the plans remain the property of the Department.

B. Transport items to the specified location.

C. Remove foundations to a depth of at least 6 inches below the existing surface.

D. Backfill all holes with local material and compact to the density of the surrounding area.

3.13 INSTALL VIDEO DETECTION

A. Install all video detection components in accordance with the manufacturer specifications.

B. Mount each video detection camera on the signal mast arm using the State-Furnished 46-inch extension pole and mounting bracket. Refer to SL Series Standard Drawings for camera placement mount.

C. Install video detection cameras under the direction and supervision of UDOT staff as specified. Provide a fully functional detection system.

END OF SECTION

SECTION 02893

OVERHEAD SIGN/VMS STRUCTURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing overhead sign structure.

B. Furnish and install sign connection hardware and catwalk as shown in the contract.

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 03310: Structural Concrete

E. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 164: High-Strength Bolts for Structural Steel Joints

C. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

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. ASTM A 36: Carbon Structural Steel

H. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

I. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

J. ASTM A 314: Stainless Steel Billets and Bars for Forging

K. ASTM A 500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

L. ASTM B 221: Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

M. ASTM B 308: Aluminum-Alloy 6061-T6 Standard Structural Profiles

N. ASTM B 429: Aluminum-Alloy Extruded Structural Pipe and Tube

O. ASTM C 1107: Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

P. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs

Q. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

R. AASHTO/AWS D1.5

S. AWS D1.1 and D1.2

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Shop Drawings:
   1. Submit five sets on 11 inch x 17 inch sheets with the department project designation data, drawing number, and sheet number in the lower right corner for all fabricated materials.
   2. All details are subject to modification or approval.
   3. Do not order materials or begin work until receiving final approval of the shop detail drawings.
   4. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.
   5. Engineer reserves the right to retain these drawings up to 14 calendar days unless they are submitted electronically in which case 7 calendar days will apply, without granting an increase in the number of working days for the project. This right applies each time the drawings are submitted.

B. Mill Test Report (MTR) for all structural steel and aluminum. Provide item number and name on all materials submittals. Refer to Section 05120.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fasteners: As specified. Meet ASTM A 314, Class 304, 18-8, Stainless Steel.

B. Foundation:
   1. Concrete: Class AA(AE). Refer to Sections 03055 and 03310.
   2. Coated Reinforcing Steel: Refer to Section 03211.
   3. Anchor bolts:
      a. Furnish anchor bolts conforming to ASTM F 1554 grade 55.
      b. Do not weld anchor bolts to reinforcing steel.
      c. Furnish nuts and washers. Refer to AASHTO M 291 and M 293.
      d. Galvanize nuts, washers, and the anchor bolts. Refer to AASHTO M 232.
      e. Remove defects from galvanized steel threads, allowing nuts to be free running by hand the entire length of threads.

C. Structural Steel: General
   1. Hot dip galvanize all structural steel after fabrication. Refer to AASHTO M 111. Structural steel may be metallized using electric arc sprayed zinc wire as an alternative.
   2. Welding design and fabrication, refer to AASHTO/AWS D 1.5 where applicable. Refer to AWS D 1.1 where not applicable.
   3. Galvanize bolts, nuts, and washers. Refer to AASHTO M 232. Use lock washers on all bolts.
   4. 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.

D. Structural Tubing and Associated Hardware:
   1. Use low carbon steel conforming to ASTM A 53 Grade B or A 500 Grade B, except use chemical composition requirements of: carbon ≤ 0.25 percent, phosphorus ≤ 0.04 percent, manganese ≤ 1.35 percent, and silicon ≤ 0.05 percent. Conform to ASTM A 36, A 53 or A 500 Grade B 35,000 psi min yield strength for other elements.
   2. Bolts: Conform to AASHTO M 164 Specifications. Use them at splice plates, mounting assemblies, and vertical supports attaching the sign and catwalk to the mounting assemblies.
   3. Nuts: Conform to AASHTO M 291 Specifications, Grade 2H or DH.

4. Washers: Conform to AASHTO M 293 Specifications. Use lock washers on all bolts except, on splice plate connections use direct-tension indicator washers instead.
5. Galvanize bolts, nuts, washers: Conform to AASHTO M 232.

E. All Other Structural Steel:
1. All other shapes and plates: Conform to AASHTO M 270 Grade 36.
2. Bolts: Conform to ASTM A 307 Specifications.
3. Stainless Steel Bolts: Conform to ASTM F 593 Type 304 Specifications.
4. Nuts: Conform to AASHTO M 291 Specifications.
5. Washers: Conform to AASHTO M 293 Specifications. Use lock washers on all bolts.
6. Galvanize bolts, nuts, washers: AASHTO M 232. Entire sign assembly with mounting brackets: Galvanize to AASHTO M 111.

F. Welding design and fabrication: AASHTO/AWS D1.5 or AWS D1.1 specifications.

G. Non-shrink grout: Conform to ASTM C 1107.

2.2 VMS CATWALK

A. Aluminum: General
1. Use 6061-T6 aluminum.
   a. Refer to ASTM B 308 for I-beams, H-beams, channels, angles, T-shape, and Z-shape members.
   b. Refer to ASTM B 429 for pipe and tube.
2. Grating: Use 5052 H32 aluminum expanded metal with the size shown in the contract. Refer to ASTM B 221.
3. Welding: Refer to AWS D1.2.

B. Steel: Refer to this Section, Article 2.1 Paragraph E if approved by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility location.

B. Verify the roadway cross-section information, sign dimensions, and clearances shown on the plan before fabrication.

C. Fabricate structural supports and catwalk.

D. Refer to Section 02466.

3.2 OVERHEAD SIGN FOUNDATIONS

A. Anchor Bolts:
   1. Provide anchor bolt template during installation of anchor bolts. Fabricate the bolt template of ¼ inch thick minimum steel plate, similar to anchor plate details. Match drill to each base plate.

B. Earthwork:
   1. Place compacted embankments before drilling.
   2. Forms drilled shaft to 12 inches minimum below finish ground surface. Refer to Section 02466.
   3. Compact backfill to a density equal to surrounding materials, before erecting post.

C. Place Coated Reinforcing:
   1. Refer to Section 02466.

D. Place Concrete:
   1. Refer to Section 02466.

3.3 INSTALLATION – GENERAL

A. Survey and construct foundations to within ± 0.02 ft horizontal and vertical tolerances, establishing base plate elevations in accordance with project plans.

B. Do not remove a sign that is being replaced until the new sign is placed, uncovered and operational.

C. Verify the design height of both vertical supports, and length of horizontal support based on the as-built foundation field survey. Meet vertical clearance requirements during construction. Obtain Engineer's approval for all dimension changes.

D. Review shop-drawings and relate to survey information to assure consistency.

E. Establish proper elevation and orientation of all signs, structures, and verify proper sign post lengths as dictated by construction slopes.

F. Cover signs that require temporary covering with an opaque non-paper material. Secure at the rear of the sign so that the sign is not damaged. Maintain covering until removed.

G. Fill the void between the base plate and top of foundation with a non-shrink grout after completing the sign erection.

H. Structural Pipe:
   1. Provide hand holes for the overhead pipe frame on one side only.
   2. Locate inserts at the bottom of the mast arm. Weld 1½ inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized plugs.
   3. Rake post as necessary during sign erection using leveling nuts to level the sign panels. 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. Tighten top nuts one-sixth turn past snug tight and retighten lower nuts to maintain full contact.

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 DEFINTIONS **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 per 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 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

MULCH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Types of mulch and application requirements.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. The manufacturer's specifications and recommended installation requirements.

B. Submit a certificate from the Utah Department of Agriculture indicating the straw has been obtained from a weed-free field if straw mulch is required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original wrapping showing the name of the manufacturer and product description.

PART 2 PRODUCTS

2.1 WOOD FIBER MULCH

A. Contact the Engineer for the UDOT Approved List of Wood Fiber Mulches. Approved list is updated annually.

2.2 STRAW MULCH

A. Clean, cereal straw from a field certified by the Utah Department of Agriculture as weed-free and noxious weed-free.

B. Air dried with maximum moisture content of 18 percent.

2.3 TACKIFIER A

A. A dry powder mixture of three hydrocolloids from natural plant sources, which has been combined with a crosslinking agent.

B. Will hydrate when incorporated in a water slurry and resist rewetting when dry on the soil surface, but allow moisture penetration into the soil.

C. Viability of six to nine months.

D. Biodegradable and nontoxic to animal and plant life.

2.4 TACKIFIER B

A. A dry powder produced from grinding the outer coating (psyllium) of the seed collected from the plant, insular plantago.

B. Will hydrate when incorporated in a water slurry and forms a firm, resilient, rewettable membrane on the soil surface.

C. Organic, non-toxic, and safe for animals and plants.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all required grading and seeding before applying mulch.

B. Apply the mulch within 24 hours after seeding or before precipitation falls. If the mulch is not installed and a precipitation event occurs creating soil erosion, replace eroded material, rework the soil, and reseed before applying the mulch.

3.2 APPLY MULCH

A. Wood Fiber Mulch:
   1. Apply wood fiber mulch, tackifier A or B, and water at the following rates per acre:
      a. Mulch: 2,000 lbs
      b. Tackifier A: 40 lbs
         Tackifier B: 150 lbs
      c. Water: 5,000 gal
   2. Mix water, tackifier, and wood fiber mulch in a hydroseeder, following manufacturer's directions.

3. Apply mulch to form an even cover over the seeded areas.
4. Extend the mulch over the top of the slope to cover all disturbed areas on cut slopes.

B. Straw Mulch:
1. Apply 2,500 lbs of straw with moisture content less than 18 percent per acre.
2. Apply straw uniformly using a blower-type mulching machine.
3. Begin application at the top of the slope working in a downward direction.
4. Extend straw mulch over the top of the slope and tie in to existing vegetation on cut slopes.

C. Straw Anchoring:
1. Demonstrate and obtain approval of the crimping procedure from the Engineer.
2. Crimp the straw into the soil on accessible slopes using a sheep's foot roller, a dull edged disk-type roller, or other approved equipment to anchor the straw into the soil without slicing the straw. Apply water to compacted or dry soils before crimping.
3. Inject a tackifier on slopes inaccessible to crimping equipment at the rate indicated above into the straw as it leaves the blower or apply a tackifier after straw is placed using a hydromulcher. Mix tackifier at rate indicated above, 5,000 gallons of water and 250 lbs. of wood fiber mulch per acre.

END OF SECTION

SECTION 02912

TOPSOIL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and spread topsoil on prepared areas.

B. Strip topsoil from on-site locations and place in stockpile.

C. Spread 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. For Contractor-furnished topsoil: A minimum of 7 working days before delivery of soil, submit to the Engineer the laboratory test results from each topsoil source to be used.

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. **EC**: (Electrical Conductivity): less than 4 ds/m
   3. **SAR**: (Sodium Adsorption Ratio): 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. AASHTO T 194.

C. Textural classification:
   1. Loam, sandy loam, silt loam, or sandy clay loam not exceeding the following percentiles. 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 5 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.

B. Soil testing: Engineer will submit soil samples to an approved independent soil testing laboratory capable of performing the tests listed in this section, article 2.1, Contractor Furnished Topsoil. A partial list of acceptable testing laboratories includes:

Brigham Young University
Soil and Plant Analysis Laboratory
255 WIDB
Provo, UT 84602
(801) 422-2147

USU Analytical Laboratory
4830 Old Main Hill
Logan, Utah 84322-4830
(435) 797-2217

QA Consulting and Testing, LLC
PO Box 627
645 South 240 East
Salem, UT 84653
(801) 423-1116
(801) 423-1813 (fax)

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 feet that require the placement of topsoil. Finish according to this Section, article 3.3, Spread Stockpiled and Contractor-Furnished Topsoil, paragraph D.

C. Provide a suitable topsoil surface just before seeding on the remaining top soiled areas not covered under this article, paragraph B. Suitable topsoil surface is:
1. Non-compacted surface finished according to this Section, article 3.3.
2. Weed free.

3. Finish grade provides a 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 identified on the plans or approved by Engineer.
   2. To a depth approved 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.

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. Copy of the purchase order to the Engineer documenting that all seeds, including substitutions, have been acquired before the seeding window begins.
   1. Refer to this Section, article 1.6, Scheduling for seeding information.
   2. List the common and botanical name for each seed species on the purchase order.

B. Certification that turf sod is nursery grown and contains a minimum of three varieties of Kentucky Blue Grass.

C. Certification indicating the date and time sod was cut at the nursery.

D. Furnish fertilizer labels to Engineer.

E. Through the Engineer, supply legible copy of Seed Certification Reports to Region Landscape Architect.

F. 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)

1.6 DELIVERY, STORAGE, AND HANDLING

A. Mixing Seed:
   1. Notify Engineer seven calendar days prior to seed mixing.
   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 UDOT 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: Complete all general roadside seeding within the appropriate seeding window.
   1. Postpone seeding until the following year if the seeding is not completed within the given window.
   2. Exception to this window under certain conditions may be obtained through the Region Landscape Architect. The Engineer approves exceptions.

Elevation	Seeding Window
Below 4,000 ft	Oct. 1 to Dec. 31
4000 to 6,000 ft	Sept. 15 to Dec 1
Above 6,000 ft	Sept. 1 to Nov 15

C. Turf seed and turf sod can be placed only after irrigation system is installed and operational.

D. Topsoil: Refer to Section 02912.
   1. Place topsoil just before seeding to eliminate competition from weeds.
   2. 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. Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST).
   1. Seed germination test older than 18 months for grass seed, and nine months for shrub, or tree seed are not acceptable.
   2. Based on the amount or type of seed required on a project, UDOT 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. Engineer will contact the Region Landscape Architect to verify the seed is unavailable and to recommend a seed substitution.
   3. Replace originally specified seed with seed of equal or greater cost.

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 ¾ inch and 1 inch.

2.3 FERTILIZER (For turf sod and turf seed areas only)

A. Uniform in composition, dry, and free flowing.
   1. For turf seed or turf sod: Elemental nitrogen in granular form. Phosphorus, and potassium are optional and may be applied with nitrogen in granules. A minimum of 50 percent of nitrogen shall be in a slow release form 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. Before any seed or sod work begins, properly prepare the topsoil surface and have it approved by the Engineer. Refer to Section 02912.
   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 yd^2 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 blow the top of all walks, curbs, mow strips and other hard surfaces.
   2. Apply fertilizer at the rate of 2 lb/100 yd^2 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 gallons to 10 gallons of water.
   4. Lightly rake and dampen with water the top ⅛ to ⅝ inches of soil just before laying the sod.

3.2 SEEDING

A. Notify the Engineer seven working days before seeding.

B. Apply seed at the rate indicated in the Seed Schedule shown in the plans. Note that drill seed and broadcast seed are applied at different rates.

3.3 DRILL METHOD

A. Use the drill method of seeding on accessible slopes 3:1 and flatter.

B. Use a rangeland type 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. Provide the Engineer a copy of the manufacturer's directions on drill calibration two working days before seeding.

D. 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.

E. Space drill rows a minimum of 6 inches and a maximum of 8 inches.

F. Fill the seed boxes no more than half full when drilling on a slope.

G. Set depth bands to drill seeds to a ½ inch depth.

H. Drill along the contour.

I. Maintain the drill at the calibrated setting throughout the seeding operation.

J. Allow the furrows that are created by the drill to remain.

3.4 BROADCAST 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. Where the area to be seeded is not large enough to justify using a drill.
   4. Where rocky surface conditions would damage a drill.

B. Obtain approval of the broadcast method by demonstrating the procedure on a 100 yd^2 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, 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. 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 mulch, blanket, 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 LAY SOD

A. Refer to this Section, article 1.6, paragraph C for timing.

B. 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.

C. Lay turf sod with staggered joints and trim off excess material along the edges.

D. 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 ⅓ of the branches from any tree or shrub when obtaining poles and cuttings from vegetation that will remain within the right-of-way.

F. The Engineer will determine the size of poles and cuttings:
   1. Pole: Cut branches at a 45 degree angle, 6 ft long and 1 inch 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 ⅓ to ¾ 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. Dig a hole deep enough to accommodate 90 percent of the length of the cutting.

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. 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. Plant substitutions:
   1. Obtain a signed statement from three wholesale nurseries, noted for stocking the specified plants, indicating that the plants are unavailable.
   2. Submit to the Engineer 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. All necessary inspection certificates for each shipment of plants as required by Utah Laws and Regulations.

1.6 QUALITY ASSURANCE

A. Reject plants not meeting 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. Replace all wilted, windburned, or stressed plants at no additional cost to the Department.
   2. 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 PLANT INSPECTION AND ACCEPTANCE

A. Replace unacceptable plant material within 14 days after notification from the Engineer.

B. Inspect plants only after all plant materials have been installed.

C. The Engineer schedules the inspection date.

D. Make the required field adjustments and changes following the inspection.

1.9 SCHEDULE

A. Install irrigated plants using the following schedule:

Elevation	Planting Season
Below 4,000 ft*	March 1 - December 1
4000 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, abrasions of the bark, 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. Use no 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 written approval by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that area prepared to receive plants is graded properly as per plan, all work is completed in the area, and that topsoil has been placed. Refer to Section 02912.

B. Have the irrigation system installed and fully operational before installing plants.

C. Stake or delineate locations of plants for approval before installation.

3.2 INSTALLATION

A. General
   1. Install plants using the plan details.
   2. Within one hour of installation, water the plants to saturate the rootball to a minimum of 4 inches below and around the plant hole. 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. Reject mishandled or plants with broken root balls.
   4. Remove 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. Selectively remove and dispose 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. Obtain necessary permits from the municipality, city forester, or both in which the work is performed and submit a copy of the permits to the Engineer seven calendar days before work begins.

B. A copy of the arborist's certificate from I.S.A.

1.6 QUALITY ASSURANCE

A. Contractor must provide an I.S.A. 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.

B. Prune trees following listed references.

C. Remove tree branches extending over the roadway to provide a clear height of 15 ft above the paved surface and 10 ft above sidewalks.

D. Spray pruning equipment with disinfectant after coming in contact with diseased plant material.

E. Use the “Natural Target” or “Drop Crotch” pruning method when removing limbs.

F. Do not top, pollard, stub, or dehorn any tree.

G. 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.

H. Prune trees to make them shapely, symmetrical, and typical of the natural form of the species being pruned.

I. 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 directed 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. Mill the existing bituminous surface at the location and to the depth specified in the plans.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. Section 02741: Hot Mix Asphalt (HMA)

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMIMTTALS **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 ⅝ inch between the cutting teeth on the mandrel.

B. Use appropriate cleaning equipment capable of sweeping and picking up millings to clean up after milling operation.

PART 3 EXECUTION

3.1 PROCEDURE

A. Rotomill existing bituminous pavement surface to the width and depth shown on the plans to an accuracy of ± ⅜ inch of plan depth, measured from original surface to the top of the ridge.
   1. Maintain depth tolerance. Do not use skis or other profile grade control devices if the specified depth tolerance cannot be met with their use.

B. Rotomill the area directly surrounding manholes, catch basins, water meters, water valves or any other permanent fixtures to the specified depth.

C. 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 adjust the depth of the milling operation, within tolerances, to remove unacceptable material or to improve ride.

D. 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 prior to opening to traffic. Meet environmental regulations following Section 01355 for cleaning process.

B. Remove and replace or repair damage caused by the Contractor's operation outside of the widths and depths shown in the plans. Repair at Contractor's expense. Damage to traffic due to loose material on milled surface repaired at Contractor's expense.

C. Dispose of the milled material in a manner approved by the Engineer. Refer to Section 01355.

END OF SECTION

SECTION 02962

IN-PLACE COLD RECYCLED ASPHALTIC BASE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill existing asphalt material to required depth and width.

B. Mix with emulsified asphalt, quick lime slurry, and water if required, place to line and grade and compact.

1.2 RELATED SECTIONS

A. Section 02745: Asphalt Material

1.3 REFERENCES

A. AASHTO T 26: Quality of Water to be Used in Concrete

B. AASHTO T 166: Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

C. AASHTO T 245: Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

D. ASTM C 110: Standard Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone

E. ASTM C 977: Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization

F. ASTM D 2950: Test Method for Density of Bituminous Concrete in Place by Nuclear Method

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit mix design for Engineer's approval prior to starting cold recycling operation.

B. Provide a Manufacturer's Certificate of Compliance for Quick Lime.

1.6 ACCEPTANCE

A. The Department runs five density tests on each test lot.
   1. A test lot is defined as the amount of cold recycled material placed during one full day's production.
   2. Each density test consists of the mean of three in-place nuclear wet density tests. ASTM D 2950.
   3. Establish the target density by obtaining a sample of loose material from the roadway just ahead of the rolling operation.
      a. Heat sample in oven at 140 degrees F for two hours maximum.
      b. Compact mix immediately using standard 50 blow Marshall procedure. AASHTO T 245.
      c. The target for roadway compaction is 96 percent of the mean of 3 Marshall briquettes for each test lot. AASHTO T 166.

B. The Engineer verifies the surface with a 10-ft straightedge at selected sites. Correct surface variations in excess of ⅜ inch by removing or adding material.

1.7 PAYMENT PROCEDURES

A. Include all costs for quick lime slurry in the item In-Place Cold Recycled Asphaltic Base.

PART 2 PRODUCTS

2.1 MATERIALS

A. In-Place Cold Recycled Asphaltic Base gradation:

Sieve Size	Percent Passing
1½ inch	100

B. Use asphalt emulsion as shown on the plans. Refer to Section 02745.

C. Use high calcium pebble quick lime (Hot hydrated lime slurry) that has a minimum dry solids content of 35 percent by weight and that is a pumpable suspension of solids in water. Quick lime slurry must conform to ASTM C 977 using test method ASTM C 110.

D. Use 1.5 percent quick lime by weight of cold recycled base.

E. Use potable water for the quick lime slurry. Refer to AASHTO T 26.

2.2 EQUIPMENT

A. Use self-propelled equipment with sufficient power, traction and stability to maintain an accurate depth of cut.

B. Use equipment that will process full depth and lane width in one pass, with screening and crushing capability.

C. Use a machine capable of mixing the pulverized material, emulsified binding agent, and quick lime slurry to a homogeneous mixture.

D. Provide lime slurry equipment that accurately proportions quick lime and water, mixes these ingredients to obtain proper slaking, and maintains a uniform, homogenous slurry. Agitate slurry sufficiently to prevent separation while transporting. Add the lime slurry to the pulverized surfacing by a spray bar at the cutting head on the mill. Accurately meter the slurry into the recycled materials.

E. Use a mixing machine capable of placing the mixed material into a windrow or directly into the hopper of a paver.

F. Separate machinery may be used for mixing.

G. Use a positive displacement pump capable of accurately metering the required quantity of additive down to a minimum rate of 4 gallons per minute.

H. Use a mixing machine that has a meter capable of measuring the flow and total delivery of the additive.

I. Use a machine capable of picking up the entire windrow when a pick-up machine is used to feed the paver.

J. Use 30-ton minimum pneumatic rollers.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean or clear away all debris and vegetation within 1 ft of pavement edge.

3.2 RECLAIMED MATERIALS

A. Mill pavement to required depth and width.

B. Control dust created by the cutting action.

C. Crush or screen the reclaimed material to pass a 1½ inch sieve.

D. Reclaimed material must be free of organic materials, soil, or other foreign substances.

3.3 PLACEMENT

A. Place the mixed material with a self-propelled asphalt paver.

B. Adjust emulsion content as pavement conditions change. Repair reclaimed materials when surface ruts or ravels before placement of final wearing surface.

C. Use watering device to prevent materials from adhering to the tires for breakdown or intermediate rolling.

D. Add water to milled material as necessary to facilitate uniform mixing.

E. Continue breakdown rolling until no displacement is noted.

F. Use steel wheel rollers in static or vibratory mode as required for final rolling.

G. Wait 72 hours after a rain or confirm that moisture content is less than 1.5 percent before placing flush, tack, or final surfacing on cold recycled material.

3.4 LIMITATIONS

A. Do not disturb underlying crushed aggregate base.

B. Do not heat screed.

C. Do not park roller or leave idle on uncompacted recycled surface.

D. Perform recycling operations when ambient temperature exceeds 50 degrees F in the shade and pavement temperature exceeds 70 degrees F. Stop recycling operations when weather is foggy or rainy.

E. Prohibit traffic on compacted recycled material for 2 hours after compacting is completed. Remove all loose aggregates by power brooming before allowing traffic on the compacted recycled material.

END OF SECTION

SECTION 02963

PROFILE ROTOMILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill the existing bituminous surface at the location and to the profile and cross- slope specified in the plans.

1.2 RELATED SECTIONS

A. Section 01355: Environmental Protection

B. 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 the plan cross slope.
   2. Self-propelled with sufficient power, traction, and stability to maintain accurate depth of cut.
   3. Maximum of ⅝ inch between the cutting teeth on the mandrel.

B. Use appropriate cleaning equipment capable of sweeping and picking up millings to clean up after milling operation.

PART 3 EXECUTION

3.1 PREPARATION

A. The Engineer measures and records profile grades during rotomilling operation:
   1. Use a means that provides the required accuracy.
   2. Take two random measurements for every 1,000 ft of each pass.

B. Achieve a rotomilled depth in the field of plan depth ± ¼ 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 on the plans.

D. Clean rotomilled surface after milling operation and prior to opening to traffic. Meet environmental regulations following Section 01355 for cleaning process.

E. Remove and replace, or repair damage by the Contractor's operation outside of the widths and depths shown in the plans. Repair at Contractor's expense. Repair damage to traffic due to loose material on milled surface at Contractor's expense.

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. Remove and clean all millings from the surface daily. Control dust created by the cutting action.

H. Milled material is the property of the Contractor unless specified otherwise by the Engineer.

I. Dispose of the milled material in a manner approved by the Engineer. Refer to Section 01355.

J. Rotomill the area directly surrounding manholes, catch basins, water meters, water valves or any other permanent fixtures to the specified depth.

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 01452: Pavement Smoothness

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 necessary 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 smoothness required.

B. Provide a uniform finished texture.

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. Use a distance between the grooves of between 0.060 and 0.13 inches. Make peaks of the ridges approximately $^{1}/_{16}$ 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 ¼ 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 01452. Determine pavement smoothness with the following change.
   1. Provide finished pavement surface with an average profile index not greater than 2 inches per mile.

END OF SECTION

SECTION 02982

BRIDGE CONCRETE GRINDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedure for grinding new concrete bridge decks and approach slabs for precast concrete deck panel system or as shown on the plans.

1.2 RELATED SECTIONS

A. Section 01452: Pavement Smoothness

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 GRIND

A. Grind concrete bridge deck until the surface of both sides of closure-pour and deck-panel joint are in the same plane and meet the smoothness required.
   1. Cure shear stud blockout locations for 24 hours before grinding.
   2. Meet the straight-edge requirements after grinding for all locations.
   3. Maximum depth of milling is ¼ inch.

B. Provide a uniform finished texture.

C. Perform grinding in a longitudinal direction.
   1. Begin and end grinding at lines normal to the bridge centerline.

D. Do not damage the deck.

E. Create a surface in a parallel, corduroy-type texture consisting of grooves between $^{1}/_{16}$ and ⅛ inches wide.
   1. The peaks of the ridges need to be approximately $^{1}/_{16}$ inch higher than the bottom of the grooves.

F. Maintain cross slope drainage.

G. Provide uniform transverse and longitudinal slope of the concrete deck with no depressions or misalignment of slope greater than ⅛ inch in 10 ft when tested with a 10-ft straightedge.

H. All tailings from the grinding process become property and responsibility of the Contractor.

3.2 SMOOTHNESS TESTS

A. Refer to Section 01452.

END OF SECTION

SECTION 03055

PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for producing portland cement concrete.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 6: Standard Specification for Fine Aggregate for Portland Cement Concrete

B. AASHTO M 80: Standard Specification for Coarse Aggregate for Portland Cement Concrete

C. AASHTO M 154: Standard Specification for Air-Entraining Admixtures for Concrete

D. AASHTO M 157: Standard Specification for Ready-Mixed Concrete

E. AASHTO M 194: Standard Specification for Chemical Admixtures for Concrete

F. AASHTO M 295: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

G. ASTM C 150: Standard Specification for Portland Cement

H. ASTM C 595: Standard Specification for Blended Hydraulic Cements

I. ASTM C 1157: Standard Performance Specification for Hydraulic Cement

J. ASTM C 1240: Standard Specification for Silica Fume for Used in Cementitious Mixtures

K. ASTM C 1567: Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

L. ASTM C 1602: Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

M. American Concrete Institute (ACI) Standards

N. Precast/Prestressed Concrete Institute (PCI)

O. UDOT Materials Manual of Instruction

P. UDOT Minimum Sampling and Testing Requirements Manual

Q. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Furnish to the Engineer a mix design for each class of concrete to be used.
   1. Base concrete mix designs for all "A" concrete classes on trial batch test results or on UDOT's past project history using the same materials used in previous mix designs within the past year.
   2. Use the same components in the trial batches that are to be used in the project including coarse and fine aggregate, water, source and type of cement, air-entraining agent, fly ash, etc., including any site-added admixtures intended to be used.
   3. Do not exceed 30 percent total pozzolan in any mix unless otherwise specified.
   4. The Department or its representative witnesses the trial batch.
   5. Mix concrete trial batches as specified in UDOT Materials Manual of Instruction Part 8-974: Guidelines for Portland Cement Concrete Mix Design.
   6. Meet the following additional requirements for Self Consolidating Mixes (SCC):
      a. Design and mix according to ACI Manual of Concrete Practice 301: Specifications for Concrete.
      b. Provide mix specific flow and spread criteria.
      c. Meet PCI – TR-6-03. A visual stability index rating of 0 – 1 is required.
      d. Provide compressive strength data.
      e. Include documentation justifying any deviation from the aggregate operating bands required by Table 4 with the mix design for approval. Production may not begin until the deviation is approved.

B. Test results verifying the coarse and fine aggregate used meets this section, article 2.2

C. Verification that cement used is from a pre-qualified supplier. See this Section, article 2.1, paragraph E.

D. Verification that fly ash used in from a pre-qualified supplier. See this Section, article 2.5, paragraph A.1.d.

E. Verification that the batch plant meets the requirements of the UDOT Quality Management Plan for Ready-Mix Concrete.

1.6 ACCEPTANCE

A. Acceptance is in accordance with UDOT Minimum Sampling and Testing Requirements.

B. When concrete is below specified strength and does not have a separate strength pay factor:
   1. Department may accept item at a reduced price.
   2. The pay factor will be applied to the portion of the item that is represented by the strength tests that fall below specified strength.
   3. Department will calculate the pay factor as follows based on 28 day compressive strength:

Psi below specified strength:	**Pay Factor:**
1 – 100	0.95
101 – 200	0.90
201 – 300	0.85
301 – 400	0.80
More than 400	0.50 or Engineer may reject

PART 2 PRODUCTS

2.1 CONCRETE CLASSES AND MIX REQUIREMENTS

A. Meet the requirements in Table 1.

Table 1

Concrete Classes and Mix Requirements							
Class	**Coarse Aggregate or Sieve Size**	**Max. Water/ Cementitous Ratio**	**Min. Cementitous Content (lb/yd^3)**	**Slump (Inch) See Article G for further Criteria**	**Air Content Percent (%)***	**Mix Design Compress *f'*cr (Psi)**	**28 Day Minimum Compress *f'*c (Psi) ** **
AA(AE)	2" to No. 4	0.44	564	1 to 3.5	4.0 - 7.0	5200	4000
	1-½" to No. 4	0.44	564	1 to 3.5	4.5 - 7.5	5200	4000
	1" to No. 4	0.44	611	1 to 3.5	5.0 - 7.5	5200	4000
	¾" to No. 4	0.44	611	1 to 3.5	5.0 - 7.5	5200	4000
A(AE)	1-½" to No. 4	0.53	470	1 to 3.5	4.5 - 7.5	3900	3000
	1" to No. 4	0.53	470	1 to 3.5	4.5 - 7.5	3900	3000
	¾" to No. 4	0.48	517	1 to 3.5	4.5 - 7.5	3900	3000
B or B(AE)		0.62	376	2 to 5	-- 3.0 - 6.0	3250	2500

* Values listed represent in-place air content. Make necessary adjustments for impacts to air content due to placement.

** For *f'*c over 4000 psi, design and proportion mixes according to ACI Manual of Concrete Practice 301: Specifications for Concrete and project specific criteria.

B. Minimum strength is based on a coefficient of variation of 10 percent, and one test below the minimum strength per 100 tests.

C. Maximum nominal size of coarse aggregate:
   1. Not larger than $^1/_5$ of the narrowest dimension between sides of forms.
   2. Not larger than ⅓ the depth of slabs.
   3. Not larger than ¾ of the minimum clear distance between reinforcing bars or between bars and forms, whichever is less.

D. Do not exceed water/cementitous ratio.

E. Calculate the water/cementitous ratio (w/c) according to the following formula:

$$\frac{W}{C} = \frac{Water}{Cement + Pozzolan}$$

F. Use 94 lb more cement per cubic yard when concrete is deposited in water than the design requires for concrete placed above water.

G. Use Table 4 to determine the slump requirements when not using water-reducing admixtures or viscosity modifying admixtures.
   1. Slump requirements when using low range water reducers: 1 inch to 5 inches for all classes of concrete.
   2. Slump requirements when using high range water reducers: 4 inches to 9 inches for all classes of concrete.
   3. Slump requirements when using viscosity modifying admixtures: None. Meet visual stability index of 0 – 1.

2.2 CEMENT

A. Use type II portland cement or blended hydraulic cement unless otherwise specified. (ASTM C 150, ASTM C 595, ASTM C 1157)

B. Portland Cement
   1. Follow Tables 1 and 3 in ASTM C 150.
   2. Follow the requirements of Table 2 of ASTM C 150 for low-alkali cement.

C. Blended Hydraulic Cement.
   1. When blended hydraulic cement is substituted for portland cement:
      a. Use ASTM C 1567 to verify that expansion is less than 0.1 percent at 16 days.
      b. Refer to the equivalent cements listed in Table 2.
   2. Do not exceed 30 percent total pozzolan limit when adding flyash to a blended hydraulic cement.
      a. Submit documentation of the total pozzolan content with the mix design.

Table 2

Portland Cement/Blended Hydraulic Cement Equivalencies		
ASTM C 150 (Low Alkali)	**ASTM C 595**	**ASTM C 1157**
Type I	IP	GU
Type II	IP (MS)	MS
Type III	-	HE
Type V	-	HS

D. Do not use cement that contains lumps or is partially set.

E. Use cement from the list of UDOT qualified suppliers list maintained by the UDOT Materials Quality Assurance Section.

F. Do not mix cement originating from different sources.

G. Do not use air-entrained cement.

H. Department will sample and test the cement in accordance with UDOT Quality Management Plan 502: Cement.

2.3 AGGREGATE

A. Coarse Aggregate for Normal Concrete Mixes
   1. Use coarse aggregate meeting AASHTO M 80 physical properties. Use one of the gradations found in Table 2.
   2. Do not exceed 1 percent of deleterious substances as shown in AASHTO M 80, Table 2, for Class A aggregates. Material finer than No. 200 sieve: maximum allowable 1 percent, exception as noted in footnote d.

Table 3

Aggregate Gradations - Percent Passing (by weight)								
Aggregate or Sieve Size (inches)	**2½**	**2**	**1½**	**1**	**¾**	**½**	**⅜**	**No. 4**
2 to No. 4	100	95-100		35-70		10-30		0-5
1½ to No. 4		100	95-100		35-70		10-30	0-5
1 to No. 4			100	95-100		25-60		0-10
¾ to No. 4				100	90-100		20-55	0-10

B. Fine Aggregate for Normal Concrete Mixes
   1. Use fine aggregate meeting AASHTO M 6 physical properties. Use the gradation found in Table 3.
   2. Do not exceed 3.0 percent of deleterious substances as outlined in AASHTO M 6, Table 2, for class A aggregates, using option “b” for material finer than the No. 200 sieve. Material finer than No. 200 sieve: maximum allowable 3 percent.

Table 4

Gradation	
Sieve Size	**Percent Passing (by weight)**
⅜ inch	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

C. Coarse and Fine Aggregate for Self Consolidating Concrete (SCC) Mixes.
   1. Combined gradations of coarse and fine aggregates must be within the bands shown in Table 4. Establish targets and production tolerances necessary to meet the requirements of Table 4.

Table 5

Aggregate Gradations (Percent Passing by Dry Weight of Aggregate)		
Sieve Size	**¾ inch Operating Bands**	**½ inch Operating Bands**
¾ inch	95 – 100	–
½ inch	65 – 95	95 –100
⅜ 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 – 2	0 – 2

2.4 WATER

A. Use potable water or water meeting ASTM C 1602, including Table 2.

B. Screen out extraneous material when pumping water from streams, ponds, lakes, etc.

2.5 ADMIXTURES

A. Air Entrainment: as specified. Meet AASHTO M 154, including Section 5.

B. Water Reducing Agents: Meet AASHTO M 194.
   1. High Range Water Reducer (HRWR): Submit a written plan for approval with the trial batch that shows proper attention will be given to ingredients, production methods, handling and placing.
   2. Do not use calcium chloride.

C. Accelerators: Meet AASHTO M 194
   1. Use non-chloride accelerators.

D. Set Retarding Admixtures: Meet AASHTO M 194.
   1. Establish the effective life of the set-retarding admixture by trial batch if set retarding admixtures are required due to haul times exceeding the time limitations in this Section, article 3.4, paragraph A.

2. Do not exceed any manufacturer recommendations for the use of the set-retarding admixture.
3. Do not re-dose the concrete with additional set retarding admixture.
4. Add set retarding admixture at the batch plant at the time of initial batching operations.
5. Show on batch tickets the amount of admixture used.
6. Time of placement is established by the trial batch and supersedes the requirements in this Section, article 3.4, paragraph A.

E. Viscosity Modifying Admixtures.
1. Do not exceed any manufacturer recommendations for the use of the viscosity modifying admixture.
2. Do not re-dose the concrete with additional viscosity modifying admixture.
3. Show on batch tickets the amount of admixture used.

F. Site-added admixtures.
1. Use admixture in the trial batch.
2. Use pre-measured admixtures only.
3. Record amount used on batch ticket.
4. Rotate the drum at least 30 revolutions at the mixing speed recommended by the manufacturer.

2.6 POZZOLAN

A. Fly Ash:
1. Class F, as specified. Conform to AASHTO M 295 except table 2.
   a. Replace a minimum of 20 percent of the portland cement by weight unless otherwise specified. Use the minimum cement content in the design formulas before replacement is made.
   b. Loss on Ignition (LOI): not to exceed 3 percent.
   c. Maximum allowable CaO content: not to exceed 15 percent.
   d. Use fly ash from the list of UDOT pre-qualified sources maintained by the UDOT Materials Quality Assurance.
   e. Label the storage silo for fly ash to distinguish it from cement.
   f. Use different size unloading hoses and fittings for cement and fly ash.
2. Fly ash may be sampled and tested for compliance at any time.

B. Natural Pozzolan (Class N)
1. Conform to AASHTO M 295.
2. May use instead of fly ash provided that the expansion, according to ASTM C 1567, does not exceed 0.1 percent.

C. Silica Fume: Conform to ASTM C 1240.

PART 3 EXECUTION

3.1 PREPARATION

A. Aggregate stockpiles:
1. Construct stockpile platforms so that subgrades are prevented from intruding into aggregates.
2. Build stockpiles at least two days before use.
3. Provide an operator and front-end loader to help the Engineer take aggregate samples.
4. Aggregate may be accepted in daily increments, but not more than 30 days before use.
5. Provide separate stockpiles for coarse and fine aggregate.
6. Construct stockpiles to minimize segregation of aggregate
7. Allow washed aggregates to drain to uniform moisture content before use (12 hours minimum).

3.2 BATCH MATERIALS

A. Meet AASHTO M 157.

B. Hand Mixing:
1. Only Class B concrete may be hand mixed.
2. Hand-mixed batches cannot exceed 0.5 yd^3.
3. Hand mix on a watertight platform.
4. Spread the aggregate evenly on the platform and thoroughly mix in the dry cement until the mixture becomes uniform in color.

C. Truck-Mixed Concrete (Dry-Batch):
1. Do not load trucks in excess of their rated mixing capacity, or 63 percent of the drum gross volume, or less than 2 yd^3.
2. The truck rating plate must be readable.

3.3 MIX DESIGN

A. Do not place concrete without written approval of the mix design.

B. Do not change the mix design without written approval.

3.4 LIMITATIONS – GENERAL

A. Timing. Unless otherwise specified, place concrete:
   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 between 86 and 90 degrees F.
   4. Prior to initial set.

B. Concrete Temperature: Unless otherwise specified, place concrete in the forms when the concrete temperature is between 50 and 90 degrees F.

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 one half of the range of air content allowed by specification.
   2. Contractor is responsible for verification and monitoring of air loss.

3.5 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. Engineer stops placement of concrete if the storage device cannot accommodate the required number of test cylinders.
   6. Use water containing hydrated lime if water is to be in contact with cylinders.
   7. A 24-hour test run may be required.

END OF SECTION

SECTION 03152

CONCRETE JOINT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joint Filler and Joint Sealer

B. Waterstops

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete

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 (Nonextruding and Resilient Bituminous Types)

D. AASHTO T 132: Tensile Strength of Hydraulic Cement Mortars

E. AASHTO Standard Specifications for Highway Bridges

F. ASTM C 509: Elastomeric Cellular Preformed Gasket and Sealing Material

G. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

H. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

I. ASTM D 794: Determining Permanent Effect of Heat on Plastics

J. ASTM D 1084: Viscosity of Adhesives

K. ASTM D 1621: Compressive Properties of Rigid Cellular Plastics

L. ASTM D 1622: Apparent Density of Rigid Cellular Plastics

M. ASTM D 1623: Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics

N. ASTM D 2240: Rubber Property-Durometer Hardness

O. ASTM D 2628: Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

P. ASTM D 3569: Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements

Q. ASTM D 5329: Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt and Portland Cement Concrete Pavements

R. ASTM D 6690: Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

S. Federal Specifications

T. Military Specifications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Silicone Joint Sealer: Furnish manufacturer's certified test results of each lot of the joint sealant material to Engineer, except for the bond to cement mortar test. Certificate must show use of primers, where applicable.

PART 2 PRODUCTS

2.1 PREFORMED ELASTOMERIC JOINT SEALANTS

A. Preformed elastomeric joint seal material made of vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer.

B. Engineer approves the shape of any joint sealer prior to submission of the individual production lot.

C. Department evaluation requirements for any joint seal geometry are:
   1. Overall width of sealer: $^{7}/_{16}$ inch minimum.
   2. Overall depth of sealer: maximum of 1 inch when compressed to $^{7}/_{32}$ inch.

3. Materials Physical Property: Conform to ASTM D 2628.
4. Maintain the force-deflection requirements in Table 1.

Table 1

Force Deflection	
Deflection Condition	**Force Requirement**
Seal compressed to ⅜ inch width Seal compressed to $^{7}/_{32}$ inch width	2 lb/inch minimum 12 lbs/inch maximum

5. Heat-age the specimens used for determining the original force-deflection relationship in an oven for 70 hours at 212 degrees F. under 50 percent deflection.
6. Subject the specimens to another force-deflection test after heat-aging and comply with the requirements in Table 2.

Table 2

Force Deflection	
Deflection Condition	**Force Requirement**
Seal compressed to ⅜ inch width Seal compressed to $^{7}/_{32}$ inch width	1 lb/inch minimum 12 lbs/inch maximum

D. Use a one-component, polycholorprene, lubricant adhesive containing only soluble phenolic resins blended with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture with the following properties:
1. Average net weight 7.8 lbs/gallon ± 5 percent.
2. Solids content by weight of 25 lbs ± 3 percent. Refer to ASTM D 1084.
3. Suitable viscosity for use with installation equipment.
4. Film strength of 2,300 psi minimum tensile strength and 750 percent minimum elongation before breaking. Refer to ASTM D 412.
5. Manufactured within 9 months of use.
6. Deliver in containers plainly marked with the manufacturer's name or trade mark, lot number, date of manufacture. Send manufacturer's certification of specification compliance.

E. Department may sample and test materials after delivery to the project site.

2.2 HOT-POURED JOINT SEALANT

A. Refer to ASTM D 6690 Type II for general requirements, physical properties, packing, marking, and sampling.

B. Test physical requirements. Refer to ASTM D 5329.

2.3 PREMOLDED JOINT FILLERS

A. Refer to AASHTO M 153 and AASHTO M 213.

2.4 SILICONE JOINT SEALER

A. Select and use a qualified sealant.

B. Silicone joint sealer and special category for self-leveling: Both made of low-modulus silicone specifically formulated to seal portland cement concrete pavement joints.

C. Furnish in a one-part, non-acid curing formulation. Refer to AASHTO M 148.

D. Meet the following physical requirements:
   1. Refer to the plan details.
   2. Backer rod compatible with the sealant and all components of the joint sealant system. Meet the requirements for Backer Rod.
   3. Prevent any bond or adverse reaction from occurring between the backup materials and the sealant.

E. Meet the test requirements in Tables 3 and 4.

Table 3

Test Requirements (Silicone Joint Sealer) and Test Methods		
Tensile Stress; 150 percent max elongation, 7-day cure at 77 ± 3 degrees F. And 45-55 percent relative humidity (rh).	45 psi	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		
Specific Gravity	1.01 - 1.515	MIL S 8802
Durometer Hardness, shore A: cured 7 days at 77 ±3 degrees F and 45-55 percent relative humidity (rh).	10-25 (0 degrees F)	ASTM D 794 Method A
Shelf life	6 month minimum from date of shipment from plant or point of manufacture.	ASTM D 2240
Ozone and Ultraviolet (UV) Resistance	No chalking, cracking, or bond loss after 5000 hours	
Bond to concrete mortar concrete briquette air cured 14 days 77 ±3 degrees F.	50 psi minimum	
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.	+100 percent and -50 percent of joint width. No more than 0.5 square inches (adhesive or cohesive) failure in the 3 specimens combined after 10 cycles.	

Table 4

Test Requirements for Self-Leveling (Silicone Joint Sealer) and Test Methods		
Flow, sag, or slump	Self-leveling	
Extrusion Rate	6-12 lbs/min.	MIL S 8802
Elongation, percent minimum	800 at 21 days	ASTM D 412 DIE C, Mod.
Modulus at 150 percent elongation	30 psi maximum after 21 days	
Tensile Adhesion +0 Concrete (minimum percent elongation)	+600 after 21 days	ASTM D 3569
Accelerated Weathering	No chalking, cracking, or bond loss after 5000 hours	
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	20-80 (0 degrees F)	ASTM D 2240
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	+100 percent and -50 percent of joint width. No more than 0.5 square inches (adhesive or cohesive) failure in the three specimens combined after 10 cycles.	

F. Department determines the bond to concrete mortar with the following test:
   1. Test as specified in AASHTO T 132.
   2. Briquettes molded as specified, sawed in half, and bonded with a thin section of sealant.
   3. Briquettes dried to a constant weight in oven at 100 ± 5 degrees F.

G. Department uses the following test following ASTM C 719 for movement capability and adhesion:
   1. Prepare 1 inch by 1 inch by 3 inch concrete blocks as specified.
   2. Use a sawed face for the bond surface.

3. Seal 2 inches of block, leaving ½ inch on each end of specimen unsealed.
4. Dimension the sealant to a ⅜ inch depth and a ½ inch width.
5. Subject sealant to movement as specified.
6. Magnitude of the movement must meet each specific category, and the rate of extension or compression must be ⅛ inch per hour.

H. Take one or more random samples (minimum of 2 quarts per sample) of each lot and seal in airtight containers.
   1. Notify Engineer when stockpiles located at either the job site or the vendor's place of business are ready to be sampled.
      a. Establish job site stockpiles at least 30 working days prior to use.
      b. Establish vendor's place of business stockpiles 40 working days prior to use.
   2. The Department may take samples at the sealant manufacturing plant at least 30 days before shipment to the job site.
   3. Laboratory testing may take 30 working days after submitting samples.

I. Do not place any materials until testing is completed and materials are approved by the Engineer.

J. 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.

K. Submit Certificate of Compliance to the Engineer when the sealant is delivered to the job site. Certificate must include:
   1. Verification of test results
   2. Manufacturer's name
   3. Lot number
   4. Expiration date of the shelf-life warranty
   5. Sealer trade name
   6. Project destination
   7. Representative sealant

2.5 BACKER ROD

A. Use closed-cell, polyethylene-foam rods conforming to the requirements in Table 5.

Table 5

Backer Rod Requirements and Test Methods		
Diameter	Joint width + ⅛ inch	
Density	2 lbs/ft^3	ASTM D 1622
Tensile Strength	25 psi	ASTM D 1623
Absorption	0.5 percent by volume	ASTM C 509
Compression Deflection	25 percent at 8 psi	ASTM D 1621

2.6 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.

B. Use material that bonds tightly to the sides of the concrete groove and exhibits the physical properties in Table 6 when cured and tested after 21 days at 73 degrees F.

Table 6

Physical Properties of Joint Sealer (Structures) and Test Methods		
Modulus of Elasticity at 100 percent Elongation	132 psi	ASTM D 412
Hardness (Shore A)	40 ± 5	
Elongation (at break)	700 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile Strength	190 psi	ASTM D 412
Adhesive in Peel	20 lbs/inch	TT-S00230 C Type II, Class A
Service Range	-40 degree F to 150 degree F	TT-S-00230 C
Initial Cure, Tack Free (Depending on Temperature and Humidity)	6 to 8 hours	
Final Cure	5 to 8 days	
Staining Characteristics	Nonstaining	
Color	Gray	

2.7 WATERSTOPS

A. Provide waterstops as specified.

B. Meet AASHTO Standard Specifications for Highway Bridges, Division II, Subsection 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. Materials and procedures for placing reinforcing steel and steel welded wire fabric.

B. Coating for reinforcing steel and steel welded wire fabric.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

C. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. AASHTO M 284: Epoxy Coated Reinforcing Bars

E. ASTM A 36: Carbon Structural Steel

F. ASTM A 767: Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

G. CRSI Manual of Standard Practice

H. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Certificates of Compliance from the manufacturer.

B. Prequalify all coatings meeting AASHTO M 284 Annex A1: Prequalification of Organic Coatings for Steel Reinforcing Bars.
   1. Furnish a copy of the Prequalification Test Report to the Department's Construction and Materials Division.
   2. Provide an 8 oz sample of the coating material from each batch in conformance AASHTO M 284 Annex A1.2.2, to the Department's Construction and Material Division.

C. Purchase order or a detailed letter to the Engineer verifying the warehouses or fabricators of the steel reinforcing bars or welded wire reinforcement with required samples.

D. Splice Shop Drawings: Submit five sets for approval showing the proposed number and locations of each mechanical butt splice splicing.
   1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.

E. Submit two sample mechanical butt splices and test to destruction in the presence of the Engineer.

F. Reinforcing Steel Shop drawings.
   1. Submit before ordering the reinforcing steel whenever splicing requirements vary from the plans and specifications, including all lengths including splices.

1.6 QUALITY ASSURANCE

A. The Department may witness coating processes for project work and obtains random samples by heat number and manufacturer to conduct verification testing.

B. Prequalification:
   1. Epoxy Coating Suppliers: UDOT Quality Management Plan (QMP) - Reinforcing Steel Epoxy Coating.
   2. Galvanized Coating Suppliers: UDOT QMP - Reinforcing Steel Galvanized Coating.
   3. Reinforcing Steel Suppliers: UDOT QMP for steel.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not damage the bars or 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 bars or coating at no additional cost to the Department.

C. Store bars above the surface of the ground on platforms, skids or other supports.

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 and not covered by concrete, by covering with an opaque covering prior to 30 days exposure to sunlight.
2. Place the opaque coverings in a manner to provide air circulation and prevent condensation on the reinforcing steel.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

A. Deformed billet-steel bars as specified. Meet AASHTO M 31, Grade 60

2.2 EPOXY AND GALVANIZED COATINGS

A. As specified. Meet AASHTO M 284 OR AASHTO M 111.

B. Coat bars as shown on the plans.
1. Maintain epoxy coating thickness between 8 and 12 mils.
2. Maintain galvanized coating thickness as specified. ASTM A 767.
3. Coat bars after bending, unless the fabricator can show that satisfactory results can be obtained by coating before bending.
4. Reject any bent bars with visible cracks or damage in the coating.

2.3 WIRE AND WIRE REINFORCEMENT

A. Cold-Drawn Steel Wire: As specified. Meet AASHTO M 55.

B. Welded Steel Wire Reinforcement: As specified. Meet AASHTO M 55.

C. Tie Wire: 16 gauge before coating.
1. Use coated wire.

2.4 BAR SUPPORTS

A. Epoxy-coated, galvanized, or plastic-coated, or plastic bar supports:
   1. Meet the requirements of the Bar Support chart at the end of this Section.
   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. Maintain galvanized coating thickness as specified. AASHTO M 111.
   6. Maintain the thickness of epoxy or plastic coatings of at least 5 mils with no maximum.
   7. Use patching material per 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. Hanger marks on the coated bar supports that result from the coating application process are acceptable and are not considered damaged coating.

B. Precast concrete block bar supports:
   1. Minimum 28-day compressive strength of 2,500 psi
   2. Three inch thick supports with sides ranging from 4 inches to 6 inches with a minimum soil contact area of 24 in^2.

2.5 MECHANICAL ANCHORAGE DEVICE

A. Splice Coupler (Same coating system as bar)
   1. Reinforcing steel splice coupler shown by tests to be capable of developing in tension 175 percent of the strength of the reinforcing bar without damage to the concrete.
   2. Steel Plate: Meet ASTM A 36.

PART 3 EXECUTION

3.1 PLACEMENT

A. Maintain a clean surface keeping all reinforcement free from loose mill scale, loose or thick rust, dirt, paint, oil, or grease.

B. Bend all bars accurately.

C. Place all reinforcement in designated position and securely hold in position while placing and compacting concrete.

D. Wire bars together with ties at all intersections except when spacing is less than 9 inches in each direction, in which case, tie at alternate intersections.

E. Maintain the specified distance from the forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices.

F. Precast concrete block bar supports are only allowed 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 fabric 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 slab bolsters following this Section, article 2.4.

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 following this Section, article 2.4.

M. Engineer verifies placing and fastening of reinforcement in each section of work before any concrete is deposited.

3.2 FIELD CUTTING

A. Saw or shear coated bars that are specified to be cut in the field. Do not flame cut.

B. Repair the sawed or sheared end using the specified patching or repair material.

3.3 SPLICING

A. Furnish all reinforcing steel in the lengths specified.

B. Do not splice bars, except where specified.

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 lap splice No. 14 and No. 18 bars.
   1. Use mechanical butt splices when using No. 14 or No. 18 bars.
      a. Decide the number and location of the splices with the following limitations:
         1) Extend bars a minimum of 10 ft above the top of footing.
         2) Stagger splices such that no particular bar designation is spliced more than 50 percent in 5 ft.
      b. Use a standard, approved, exothermic process for mechanical butt splicing where the molten filler metal, contained by a high-strength steel sleeve of larger inside diameter than the bars, is introduced into the annular space between bars and the sleeve and between the ends of the bars.
      c. The splice must be capable of transferring the minimum ultimate tensile strength of the reinforcing bar from one bar to the other by the mechanical strength of the splice components after cooling and hardening of the filler metal.
      d. The splice must not depend on fusion of the filler metal with the bars.
         1) Do not heat the bars to their melting point during the splicing process.
         2) Do not allow the degree of heat required to affect the splice to decrease the structural properties of the bars or affect their original hardness.
      e. Splice according to the manufacturer's recommendations using the manufacturer's standard jigs, clamps, ignition devices, and other required accessories to make splices. Preheat bars where required by the manufacturer.

F. Use one of the following mechanical butt splices for bars sizes No. 3 through No. 11 when designated on the plans. Follow the manufacturer's published recommendations for equipment and splicing procedures.
   1. A full mechanical connection that develops in tension or compression at least 175 percent of the specified yield strength of the bar.
   2. As described in this Section, article 3.3, paragraph E.

3.4 BENDING

A. Bend reinforcement to the shapes specified. Refer to CRSI Manual of Standard Practice.

B. Do not heat the bars during the bending operations.

C. Cut and bend as specified.

D. Complete all bending before coating except as specified for bent bars.

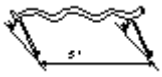
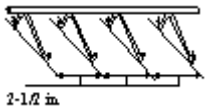
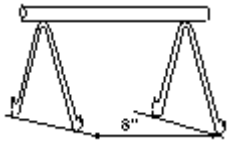
3.5 FIELD QUALITY CONTROL

A. Inspect coated bars for damage to the coating after the bars are in place and immediately before concrete placement.

B. Repair all visible defects using the specified method recommended by the coating manufacturer.

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 2½inches 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. Top wire on continuous supports, not otherwise designated as corrugated, may be straight or corrugated at the option of the manufacturer.

2. Minimum wire sizes 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 less 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
Over12	50	75

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for constructing structural concrete, including box culverts, concrete slope protection, diversion boxes, catch basins, cleanout boxes and other items as specified.

B. High Early Strength Concrete for closure joint at each end of bridge deck and the longitudinal or transverse closure joints between all the precast concrete deck panels, bridge parapets and approach slabs as shown on plans.

1.2 RELATED SECTIONS

A. Section 00555: Prosecution and Progress

B. Section 02317: Structural Excavation

C. Section 02752: Portland Cement Concrete Pavement

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

H. Section 05822: Bearings

I. Section 05832: Expansion Joints

1.3 REFERENCES

A. AASHTO M 85: Standard Specification for Portland Cement (Chemical and Physical)

B. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

C. AASHTO M 148: Liquid Membrane-Forming Compounds for Curing Concrete

D. AASHTO M 153: Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

E. AASHTO M 213: Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

F. AASHTO M 235: Epoxy Resin Adhesives

G. AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works)

H. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

I. American Concrete Institute (ACI) Standards

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Falsework Drawing:
   1. Submit for approval at least one week before construction starts, three copies of falsework drawings and design calculations signed and sealed by a professional engineer licensed in the State of Utah when required in the contract or requested by the Engineer.
   2. Comply with AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works).

B. Design and submit to the Engineer for approval when specified in the plans, a High Early Strength Concrete mix design, which attains a 24 hour compressive strength of 3000 psi and a 28-day compressive strength f_c of 4000 psi minimum. Provide a certificate stating that the mix submitted meets the requirements for coarse aggregate, fine aggregate, cement, water, admixtures and curing materials in Section 03055 at least two weeks before its use.

C. Cold Weather Plan according to this Section, article 3.8.

D. Surface Evaporation Plan according to this Section, article 3.8.

1.6 ACCEPTANCE – Price Adjustments for Strength

A. Use a pay factor of 1.0 when concrete strength meets or exceeds the specified strength.

B. When concrete is below specified strength:
   1. Department may accept item at a reduced price.
   2. The pay factor applies to the portion of the item that is represented by the strength tests that fall below specified strength.
   3. Department calculates the pay factor as follows:

Percent below specified strength:	Pay Factor:
0-2 percent	0.9
2-4 percent	0.8
4-6 percent	0.7
6-8 percent	0.6
8-10 percent	0.5

   4. Remove and replace all concrete represented by the test if the concrete strength is less than 90 percent of the specified strength.

PART 2 PRODUCTS

2.1 CONCRETE

A. Class AA(AE) concrete, unless specified otherwise.
   1. Meet a 28-day flexural strength of 650 psi verified through trial batch.

B. Concrete Slope Protection: Class A(AE).

C. Refer to Section 03055.

D. For High Early Strength Concrete use air-entrained concrete composed of portland cement, fine and coarse aggregate, admixtures, and water.
   1. Use either air-entraining portland cement or an approved air-entraining admixture to obtain the air-entraining feature.
      a. The entrained air content to be no less than 4 percent or more than 7 percent.

   2. Conform to the requirements of AASHTO M 85 for cement.

2.2 REINFORCING STEEL AND WELDED WIRE

A. Refer to Section 03211.

2.3 JOINTS AND SEALERS

A. Pre-Molded Joint Filler meeting AASHTO M 153.
   1. Concrete Slope Protection: Refer to Section 03152.

B. Preformed Joint Filler: AASHTO M 213.

2.4 BACKER ROD

A. Use backer rod composed of closed-cell polyethylene foam of sufficient size to prevent the sealant from passing to the bottom of the groove.

B. Refer to Section 03152.

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.

B. Refer to ASTM C 578.

2.7 CURING COMPOUND

A. As specified. AASHTO M 148, Type I-D, Class A.

2.8 FORMS

A. Plywood, wood, metal, glass, or a combination of these materials.

2.9 MISCELLANEOUS STEEL ITEMS

A. Galvanize all miscellaneous steel items permanently cast into structural concrete elements. Refer to AASHTO M 111.

PART 3 EXECUTION

3.1 PREPARATION

A. Falsework

1. 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.
2. Footing Construction:
   a. Build falsework on a solid footing that is safe against undermining, protected from softening, and capable of supporting any imposed loads.
   b. Demonstrate that the soil bearing values do not exceed the supporting capacity of the soil. 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 following approved falsework drawings.
3. Design and construct all falsework according to AASHTO LRFD Bridge Construction Specifications Section 3 (Temporary Works).

B. Forms

1. Use mortar-tight concrete forms, true to the dimensions, lines, and grades of the structure, and of sufficient strength to prevent deflection during the placement of concrete.
2. Discontinue using any form or forming system that produces a concrete surface with excessive undulations until modifications have been made. Undulations are excessive if they exceed either ⅛ inches or $^{1}/_{270}$ of the center-to-center distance between studs, joints, forms, fasteners, or wales.
3. 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.
4. Use lumber that is free of knotholes, loose knots, cracks, splits, warps, or other defects that affect the strength or appearance of the structure. Rough lumber may be used for forming surfaces if visible rough surfaces do not show on the final structure.

5. Form all exposed surfaces of each element of a concrete structure with the same forming material or with such materials that produce a concrete surface that is uniform in texture, color, and appearance.
6. Clean the inside surface of forms of all dirt, mortar, and foreign material before concrete placement.
7. Use form oil that permits the ready release of the forms and does not discolor the concrete.

8. 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.
9. Do not use stay-in-place deck forms unless otherwise specified.

C. Footings
1. Excavation: 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. Do not use well points to dewater footing.

3.2 GIRDERS, SLABS, AND COLUMNS

A. Deck: Cure deck concrete at least seven days and until it has attained required design strength before placing parapet forms or leave all falsework in place and design it to carry all additional loads that are part of the parapet placement process.

B. Slab Span: Place concrete in one continuous operation.

C. Cast-In-Place T-Beams:
1. Place concrete in one or two continuous operations: The first to the top of the girder stems and the second to completion.
2. Obtain a bond between the stem and slab that is positive and mechanical, and secured by means of shear keys in the top of the girder stem.

D. Concrete in columns:
1. Allow footing concrete to set until it has attained 75 percent of its strength based on field cylinder breaks 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 before placing caps.
4. Do not place concrete in the superstructure until the columns have been stripped and approved.

E. Substructure Concrete: Do not place the superstructure load on the bents or abutments until they have been in place at least seven days or attained 75 percent of the design strength based on field cylinder breaks.

3.3 BOX CULVERTS

A. Allow base slab and footing to cure until they have both attained 75 percent of their design strengths based on field cylinder breaks before the remainder of the culvert is constructed.

B. Construct side walls and top slab monolithically unless the wall height exceeds 10 ft. Keep the construction joints vertical and at right angles to the axis of the culvert.

C. When side walls and top slab are not placed monolithically, construct shear keys in the top of the side walls for anchoring the top slab.

D. Construct wingwalls monolithically.

E. Do not backfill until all concrete has attained 100 percent of its required design strength based on field cylinder breaks.

3.4 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 all depressions and humps.
3. Furnish extra material to properly finish the slopes when required.
4. Compact all soft and yielding material resulting in a firm and substantial subgrade of uniform density.
5. Thoroughly sprinkle the area with water before placing the concrete.
6. Have the Engineer approve 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 scoring as indicated on the plans.

4. Complete the entire slope protection in one placement if possible, or terminate the placement with a construction joint located in a scoring or at the junction of the slope and the abutment.
5. Finish concrete using a Floated Surface Finish according to this Section, article 3.11. Cure according to Section 03390.

C. Sealing joints and closures:
1. Furnish 1-inch thick, rigid plastic foam (styrofoam) for all expansion joints located between structural members and the slope protection.
2. Place the rigid plastic foam material against the surface of all structural members before placing the concrete slope protection.
3. Anchor the rigid plastic foam in place with a compatible adhesive or other approved methods.
4. Seal this area just before final inspection.
5. Remove curing compounds, oil, grease, dirt, and any other foreign materials from concrete surfaces and grooves by sandblasting or other permitted methods.
6. Place the backer rod and sealant after the concrete has properly cured.
7. Apply the backer rod and sealant to clean and dry concrete surfaces.
8. Place sealant with hand or power-operated caulking guns after placing the backing materials. Refer to Section 03152.
   a. Limit the depth of sealant in the groove to ⅜ inch.
   b. Start the placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical grooves.
   c. Use a concave pointing tool with soap solution to tool the sealant.
9. Do not place the sealant unless temperatures are at least 50 degrees F and rising.

D. Replacement:
1. Prepare subgrade, place concrete and seal joints and closures per this Section, paragraphs A, B and C.
2. Place concrete slope protection within seven days after removing damaged concrete slope protection. Refer to Section 03055.
3. Connect reinforcement to existing concrete slope protection to remain in place as shown in the plans.
4. Use a sealant that meets the requirements in Section 03152.

3.5 PLACE CONCRETE

A. Do not place concrete without approval.

B. Remove struts, stays, and braces that hold the forms in correct shape and alignment when no longer necessary.

C. Mix and transport concrete according to the limitations specified in Section 03055.

D. Do not deviate from the placement schedule without written approval.

E. The Engineer may postpone placement operations if the concrete cannot be protected during adverse weather.

F. Observe the following precautions when 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 such that the concrete does fill the outlet and retards concrete flow.

G. Observe the following precautions when 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 compact each layer before the preceding layer has taken initial set.
   6. Do not place concrete in water flowing under head within the area of a footing.
   7. Pass the screed over the area with a screed face device to measure the cover before concrete placement.
   8. Relocate and tie reinforcing steel that projects above the specified level before placing the concrete.

9. Raise and support reinforcing steel that is more than ¼ inch below the specified level before placing the concrete.
10. Firmly support screed rails for bridge deck slabs to prevent movement during concrete placement. When using a finishing machine, support the machine rails on the bridge beams. Do not place the machine rails on the forms unless the form supports have been strengthened and the Engineer gives written approval.

H. Observe the following precautions when compacting concrete:
1. Use high frequency internal vibrators to compact all concrete for structures except concrete placed under water.
2. Supply enough vibrators to compact 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 yd^3 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.

I. When using High Early Strength Concrete, verify that design strength has been obtained by field cylinder breaks.

3.6 PLACE CONCRETE UNDER WATER

A. Place and deposit concrete under water when specified on the plans.

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 its design strength.

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. Observe the following steps when 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. If the concrete seal around the tube is lost, re-plug the end and refill the tube with concrete.

3.7 PUMP CONCRETE

A. Place concrete with a concrete pump in good operating condition. Replace pump that causes excessive or erratic loss of air entrainment.
   1. Use a pump that produces a continuous stream of concrete without air pockets.
   2. 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 the priming or cleaning of the pump.

3.8 LIMITATIONS

A. Light the work site so all operations are plainly visible if mixing, placing, or finishing occurs after daylight hours. Refer to Section 00555.

B. Keep all traffic off concrete bridges and culverts for 14 days after final concrete placement.

C. Cold Weather:
   1. Cold weather limitations apply when the temperature is likely to fall below 40 degrees F within 14 days of placement.
   2. Comply with the following regulations for placing concrete in cold weather:
      a. Submit a written plan for approval 14 calendar days before concrete placement.
      b. Do not use chemical additives in the concrete to prevent freezing.
      c. Provide all necessary cold weather protection for in-place concrete including cover, insulation, heat, etc.
      d. Do not place concrete in contact with frozen surfaces.
      e. Produce concrete with a temperature between 60 degrees F and 90 degrees F at the time of placing.

f. Adequately vent combustion-type heaters that produce carbon monoxide.
g. Maintain the concrete temperature above 50 degrees F and below 120 degrees F with no more than a 40 degree F temperature gradient at any one time for the first 14 days after placing.
h. Protect the concrete from freezing until a compressive strength of at least 3,500 psi has been achieved.
i. Maintain moist conditions for exposed concrete not in contact with forms; avoid loss of moisture from the concrete due to heat applied.
j. 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.
k. Determine the concrete temperature with a surface thermometer insulated from surrounding air.
l. Remove and replace concrete damaged by frost action at no additional cost to the Department.

3. Heating Aggregate and Water:
   a. Provide and operate heating devices at no additional cost to the Department when heated aggregates are required.
   b. Aggregates must be free of ice.
   c. Heat aggregates uniformly, when required. Avoid overheating or developing hot spots.
   d. Use either steam or dry heat.
   e. Combined water and aggregates in the mixer before the cement is added to avoid the possibility of a quick or flash set of the concrete when either the water or aggregates are heated to above 100 degrees F.
      1) If this mixer-loading sequence is followed, water temperatures up to the boiling point can be used provided the aggregates are cold enough to reduce the final temperature of the aggregates and water mixture to less than 100 degrees F.

D. Hot Weather: Cool all form surfaces that will come in contact with the concrete to below 95 degrees F.

E. Hot Weather (Only Decks and Approach Slabs)
   1. Begin placing concrete when the temperature is declining.
   2. Begin batching operations when the air temperature in the shade is 85 degrees F or less.
   3. Discontinue placing when the temperature reaches 80 degrees F in the shade and is increasing.

F. Surface Evaporation:

1. Surface evaporation limitations apply and may occur at any time of the year, when any combination of air temperature, relative humidity, and wind velocity, that have the potential to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties. Submit a written plan for approval 14 calendar days before concrete placement that shows proper attention will be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of the concrete. Refer to ACI 305.
2. The surface evaporation plan may include any of the following actions:
   a. Construct windbreaks or enclosures to effectively reduce the wind velocity throughout the area of placement.
   b. Use fog sprayers upwind of the placement operations to effectively increase the relative humidity.
   c. Reduce the temperature of the concrete by shading the material storage area or production equipment, cool aggregate by sprinkling, cool aggregate or water by refrigeration or by replacing a portion or all of the mix water with flaked or crushed ice to the extent that the ice will completely melt during mixing of the concrete.
   d. Adjustment of the placement schedule.
   e. Use an approved water-based mono-molecular polymer liquid evaporative reducer at application rates recommended by the manufacturer. Do not use as a finishing aid.

3.9 EXPANSION JOINTS AND BEARINGS

A. Refer to Section 05832 for expansion joint information.

B. Refer to Section 05822 for bearing information.

C. Adjust bearing positions and joint widths as shown on plans.

3.10 CONSTRUCTION JOINTS

A. Make construction joints where shown on plans or in the placing schedule.

B. Obtain Engineer's written approval 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 which 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 ensure a straight vertical face. Shape the concrete below the top steel to a near vertical face in line with the bulkhead.
9. When a bulkhead cannot be placed, establish a straight vertical face by saw cutting to a minimum depth of 1 inch. Shape the concrete below the saw cut to a near vertical face.

C. Before resuming concrete placement, meet the following:
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 as specified to face of construction joints.

3.11 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 all form marks or 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 only.

3.12 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 all surfaces that cannot meet Ordinary Surface Finish requirements due to irregularities, honeycombing, excessive surface voids, discoloration, and other defects.

3.13 CONCRETE SURFACE FINISHING PROCEDURES

A. Ordinary Surface Finish:
   1. After removing forms, remove all fins and projections.
      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. For pointing, use a mortar of cement and fine aggregate, 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. Leave the full length of the joint filler exposed with clean and true edges.

B. Rubbed Finish:
   1. Wet the surface of concrete while still green, 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 five days, then rub lightly with a fine carborundum stone until smooth.
   2. For hardened concrete, use a mechanically operated carborundum stone to finish the surface at least four days after placing.
      a. Finish in the same manner as above; however, let the lather set for at least 15 days before lightly rubbing with a fine carborundum stone until smooth.
   3. Commercial grade rubbing mortar may be used if approved by Engineer.

C. Wire Brush or Scrubbed Finish:

1. After the forms are removed and the concrete is green, scrub the surface with stiff wire or fiber brushes using a solution of muriatic acid – one part acid, four parts water.
2. Once the scrubbing produces the desired texture, wash the entire surface.
3. 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. After compaction, carefully rod and strike off the surface with a strike board following the cross sections and grades shown on the plans.
   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, ensuring 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. Move the float forward one-half 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.
   b. Move the float forward one-half of its length and repeat the operation.
   c. 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, but 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. Stop finishing operations hampered by darkness unless lighting facilities are provided.
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 elevations established by the Engineer, installed to prevent springing or deflection under the weight of the finishing equipment, and placed to operate without interruption.
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. Either support finishing machine rails on the bridge beams or on form supports stiffened to prevent deflection.
   a. Obtain written approval before using form supports.
   b. This may require load tests.
10. Attach a measuring device to the screed face and pass it over the area.
11. Before placing concrete, relocate and tie reinforcing steel that projects above the specified level, and raise and support steel that is more than ¼ inch below the specified level.
12. Place concrete in a uniform heading approximately parallel to the screed machine.
13. Limit the rate of placing to allow enough time to finish the surface before initial set.
14. Continuously place concrete the full length of the structure or superstructure unit unless otherwise shown or approved.

15. Provide sufficient material, equipment, and manpower to place deck concrete at a minimum rate of 25 yd^3/hour.
16. Strike off the surface to the required elevations with the finishing machine immediately after placing and consolidating the concrete.
17. Do not add water to the concrete in front of or behind the screed.
18. Have the strike-off method and equipment approved. Maintain satisfactory performance. Use equipment capable of finishing concrete within the surface tolerances specified. Maintain satisfactory consolidation and surface tolerance to prevent shutdown and rejection of the equipment.
19. Furnish a 10 ft straightedge to check the surface tolerance, placed both longitudinally and transversely, immediately behind the screed machine and hand-finished areas.
20. Correct irregularities greater than ⅛ inch from the straightedge, before additional placement, and immediately fill depressions with concrete, and refinish.
21. Cut down and refinish high areas.
22. 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. Do not texture finish concrete deck surfaces after floating that will be covered by a water-proofing membrane system.
2. Use a texture process that produces regular ⅛ inch wide transverse grooves spaced randomly from ½ inch to ¾ inch on centers and ⅛ inch deep.
3. Keep the finished surface free from porous spots and surface irregularities.
4. Furnish a work bridge that follows the finishing machine to facilitate texturing and application of the membrane-curing compound.
5. Check the surface smoothness for acceptance after the concrete has hardened.
6. Remove irregularities by grinding if the surface deviates more than ⅛ inch from a 10 ft straightedge. Refer to Section 02752.

3.14 CURE

A. Refer to Section 03390.

3.15 FORM REMOVAL

A. Obtain approval before removing forms.

B. Remove all forms from the concrete surfaces.

C. Do not use any 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 six hours after placement.

F. To determine the condition of columns, always remove forms before removing shoring from beneath beams and girders.

G. Removing falsework:
   1. Do not remove deck falsework until the backfill at the abutments has been placed up to the bottom of the approach slab.
   2. Do not remove falsework supporting the deck of rigid frame structures until the fill has been placed in back of the vertical legs.
   3. Keep falsework and forms in place under slabs, beams, and girders for 14 days after the day of last concrete placement. Slab forms with a clear space of less than 10 ft may be removed after seven days.
   4. In cold weather, keep forms and falsework in place as approved in the written plan for cold weather concrete.

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 all irregularities caused by form joints.
   3. Fill all small holes, depressions, and voids with cement mortar mixed in the same proportions as that used in the body of the work.
   4. To patch larger holes or honeycombs, obtain a solid uniform surface by chipping away coarse or broken material.
      a. Cut away feathered edges to form faces perpendicular to the surface.
      b. Cover with epoxy-adhesive coating as specified. AASHTO M 235, Type II
      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. 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. After curing, rub patches on exposed surfaces to blend them with surrounding concrete.
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. After receiving written notice of rejection, remove and rebuild the structure in part or wholly, as specified, at no additional cost to the Department.

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 1inch below the face of slab and repair per this Section, article 2.2.
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.

3.16 MISCELLANEOUS CONSTRUCTION

A. Drainage and weep holes:
1. Construct drainage and weep holes at locations indicated on the plans or as directed.
2. Place ports or vents for equalizing hydrostatic pressure below low water.
3. Use non-corrosive materials for weep hole forms.
4. Remove wooden forms after the concrete is placed.
5. Paint exposed surfaces of metal drains as indicated on the plans.

B. Anchor Bolts: Securely and accurately set all necessary anchor bolts in piers, abutments, or pedestals as the concrete is being placed.

C. Bearing plate areas:
1. Finish bridge seat bearing areas high and rub or grind to grade level within an allowable tolerance of $\pm 1/16$ inch within a tolerance of $\pm$ ⅛ inch of the elevation shown on the plans.
2. Do not grout under bearing plates.

3.17 CLEAN

A. Clean up by removing all falsework and falsework piling down to 2 ft below the finished ground line, rubbish, and temporary building materials before final inspection.

END OF SECTION

SECTION 03311

JOINT CLOSURE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove asphalt surfacing, deck concrete, joint armor steel, and reinforcing steel at existing joint area; place new reinforcing steel; and recast joint area.

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

1.3 REFERENCES

A. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

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. Galvanized Sheet Metal: 16 gage, 0.06 inch thick.

D. Rigid Plastic Foam: Type 9, density of 2 lbs/ft^3.

E. Backer Rod: Refer to Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

A. Asphalt Removal:
   1. Make saw cuts full depth, parallel to existing joints to define removal area.
   2. Do not damage concrete deck when removing asphalt surfacing.

B. Concrete Saw Cuts:
   1. Saw Cut in concrete deck 1 inch deep and parallel to existing joints to define the work area.
   2. Note that the length of the joint closure is the width of the bridge deck adjusted for the skew of the individual structure.

C. Prevent debris from falling into streams, pedestrian areas, traffic areas, and onto railroad tracks.

3.2 REMOVE CONCRETE

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal of Concrete Slab: Use 30-pound class jack hammers or smaller.
   2. Full Depth Removal of Concrete Slab: Use 90-pound class hand operated jack hammers or smaller.
   3. Operate jack hammers at an angle greater than 45 degrees as measured from the deck surface.

B. Remove parapet concrete in the closure area. Where an existing electrical conduit is encountered, protect the conduit from damage.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel
   1. Refer to the design plans for specific directions.
   2. Thoroughly clean steel that remains in place of all corrosion and adhering materials by sandblasting.

B. New Reinforcing Steel: Place coated reinforcing steel after sandblasting operations are complete.

3.4 PLACE CONCRETE

A. Refer to Section 03055 and Section 03310.

B. Clean existing concrete and steel surfaces. Dampen before placing concrete.

C. Restrict traffic on the joint closure areas until the concrete has reached a compressive strength of 3,000 psi. Engineer may take additional concrete samples.

END OF SECTION

SECTION 03339

PRECAST CONCRETE DECK PANEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work consists of furnishing, erecting, and grouting all precast concrete deck and approach slab panels including all necessary materials and equipment to complete the work as shown on the plans.

B. Placing structural non-shrink grout into the girder camber strips and filling the shear stud blockouts in the bridge precast concrete deck panels. This is not for post-tensioning operation.

C. Procedures for preparing and installing structural non-shrink grout.

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 T 106: Compressive Strength of Hydraulic Cement Mortar

B. AASHTO T 160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

C. AASHTO T 161: Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing

D. AASHTO T 260: Standard Method of Test for Sampling and Testing Chloride Ion in Concrete and Concrete Raw Materials

E. ASTM C 666: Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

F. ASTM C 882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

G. ASTM C 1042: Standard Test Method For Bond Strength of Latex Systems Used with Concrete by Slant Shear

H. ASTM E 274: Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire

I. UDOT Quality Management Plan

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Precast Concrete Deck Panel
   1. Shop Drawings furnished to the Engineer for approval 14 days before panel construction begins:
      a. Five sets half-size, 11½ x 17 inch sheets with a 1½ inch blank margin on the left-hand edge.
      b. Place the project designation data in the lower right-hand corner of each sheet.
      c. Prepare shop drawings signed and sealed by a professional engineer licensed in the State of Utah.
   2. Department rejects units fabricated before written approval.

B. Construction Methods
   1. Provide construction methods to Engineer for approval 14 days before construction begins.
   2. Submit five copies of shop drawings to the Engineer for approval. Drawings designed by a Professional Engineer include but are not limited to the following:
      a. Type and location of lifting inserts or devices.
      b. Details of vertical adjusting hardware.
   3. Do not order materials or begin work until receiving final approval of the shop detail drawings.
   4. All details are subject to modification or approval.
   5. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.

C. Erection Plan
   1. Follow the sequence shown on the plans to remove the existing bridge deck slab and erect the new deck composed of precast concrete deck panels.

2. Submit a detailed plan to Engineer for approval 14 days before the panel erection begins. This detailed plan will include, but not be limited to the following information:
   a. Approximate location of cranes.
   b. Method of forming closure joints.

D. Structural Non-Shrink Grout
   1. Certificate of Compliance to Engineer.
   2. Submit a proposed method for forming the girder camber strips and installing the structural non-shrink grout, sequence, and equipment for grouting operation to Engineer for approval 14 days before placing structural non-shrink grout begins.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use Class AA(AE) concrete for precast concrete deck panels as specified in Section 03055 and on the plans. Self-consolidating concrete mix designs may be submitted to Engineer for approval as an alternate to the structural concrete for the precast deck panels.

B. Use coated reinforcing steel as specified in Section 03211.

C. Show vertical adjusting hardware devices on the plans. Alternative devices may be substituted with approval from the Engineer.

D. Use mechanical threaded couplers when specified for precast concrete deck panel reinforcing as specified in Section 03211.

E. Use structural non-shrink grout for girder camber strips and shear stud blockouts.
   1. Mix structural non-shrink grout just prior to use, in accordance with the manufacturer's instructions.
   2. Use concrete gray in color and containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.
   3. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.
   4. Warranty the in-place structural non-shrink grout performance and workmanship for two years.
   5. Repair or refund at the Department's option any bonding failures that occur during the warranty period.

6. Use structural non-shrink grout that meets a minimum compressive strength of 3,000 psi within 24 hours and 5,000 psi within seven days when tested as specified in AASHTO T 106.
7. 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.
8. Use structural non-shrink grout having no expansion after seven days and a one-hour compressive strength of 500 psi.
9. Refer to Table 1 for structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
***Properties**	**Requirements**	**ASTM**	**AASHTO**
Accelerated Weathering	As Specified in ASTM or AASHTO	C 666	T 260
Accepted Bond Strengths	>1,000 psi @ 24 Hours	C 882 or C 1042	
Test Medium	<3% White Utah Road Salt		T 161
Accepted Weight Loss	<15% @ 300 Cycles		T 161
Friction Number	>40	E 274	

* Certified test results from a private AASHTO accredited testing laboratory will suffice for acceptance.

F. Use a UDOT Certified Concrete Precaster or a pre-qualified project site caster for concrete products in accordance with the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

G. Cure all panels for a minimum of 14 days prior to placing on superstructure.

PART 3 EXECUTION

3.1 FABRICATION

A. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all materials in the deck panels.

B. Finish the precast concrete deck panels following Section 03310.

3.2 PLACE PRECAST CONCRETE DECK PANELS

A. Place the precast concrete deck panels as shown on the plans.

B. Check the grade of the deck panels after all deck panels in a span are placed and adjusted to provide the elevations shown on the plans.

C. After the proper grade is achieved, prevent shifting of the precast concrete deck panels during the joining of all the deck panels.

3.3 PREPARATION AND INSTALLATION OF STRUCTURAL NON-SHRINK GROUT

A. Clean and remove all debris from the girder camber strips and shear stud blockouts prior to placement of the structural non-shrink grout.

B. Keep bonding surfaces free from laitence, dirt, dust, paint, grease, oil, rust, or any contaminant other than water.

C. Pre-test the materials under field conditions at the grout pocket and camber strip anticipated to determine whether subsequent cracking will occur.
   1. The corrective action will be at the discretion of the Engineer.
   2. Proceed with grouting process at the direction of the Engineer.

D. Saturate surface dry (SSD) all surfaces receiving structural non-shrink grout.

E. Apply product following manufacturer's recommendations preparation and installation.

F. Cure structural non-shrink grout per manufacturer's recommendation.
   1. Contact the manufacturer's representative for advice on how to reduce heat such as wet curing or adding retarding admixture if the heat of hydration is excessive.

G. Use a mix design in accordance with the requirements of 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.

H. Place structural non-shrink grout in the girder camber strips and shear stud blockouts in a continuous operation within a panel after all panels and shear studs are fully installed.

I. Form the girder camber strips as shown on the plans after shear studs are installed at the locations shown on the plans.
   1. Grout the shear stud blockouts and girder camber strips using structural non-shrink grout.

J. Do not allow voids in the grout for the girder camber strips and shear stud blockouts.

K. 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 have been in place for two hours.

END OF SECTION

SECTION 03372

THIN BONDED POLYMER OVERLAY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for applying a protective crack treatment and bridge deck overlay using either an epoxy-urethane polymer (Type 1), or a Modified Epoxy polymer (Type 2) with a broadcast aggregate wearing surface.

1.2 RELATED SECTIONS

A. Section 03934: Structural Pothole Patching

1.3 REFERENCES

A. AASHTO T 242: Frictional Properties of Paved Surfaces Using a Full-Scale Tire

B. ASTM C 109: Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)

C. ASTM C 501: Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser

D. ASTM C 566: Total Evaporable Moisture Content of Aggregate by Drying

E. ASTM C 778: Standard Sand

F. ASTM D 570: Water Absorption of Plastics

G. ASTM D 638: Tensile Properties of Plastics

H. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

I. ASTM D 971: Interfacial Tension of Oil Against Water by the Ring Method

J. ASTM D 2240: Rubber Property – Durometer Hardness

K. ASTM D 4065: Standard Practice for Plastics: Dynamic Mechanical Properties: Determination and Report of Procedures

L. ASTM D 4285: Indicating Oil or Water in Compressed Air

M. American Concrete Institute (ACI)

N. California Test Method

1.4 DEFINITIONS

A. Polymer Overlay System - A two-part polymer resin system applied as a pretreatment and saturated with a broadcast aggregate before it cures. The polymer uses volumetric mixing proportions according to the Manufacturer's recommendations.

1.5 SUBMITTALS

A. Manufacturer:
   1. Submit the name of the Manufacturer of the polymer overlay materials and the name and phone number of the Manufacturer's Technical Support Representative at the Pre-Construction Meeting.

B. Certificate of Compliance:
   1. Submit to the Engineer for approval at least 10 days prior to placement a Certificate of Compliance from an independent nationally recognized laboratory stating that the polymer overlay materials meet the requirements listed in Tables 1 - 5 and other material requirements contained in this specification. Additional approval needed for any substitutes.

C. The Manufacturer furnishes at least one-quart sample of each component from each lot to the UDOT laboratory to verify material supplied.

D. Submit a Warranty letter to the Engineer and the UDOT Bridge Operations Engineer before final acceptance is given stating that the polymer Manufacturer and the Contractor jointly guarantee the wearing surface against all defects incurred during normal traffic for a period of five years, including any delamination or reduced skid resistance less than 40, as measured per AASHTO T 242.
   1. The guarantee period commences on the date of work acceptance, typically the date traffic is allowed on surface.

PART 2 PRODUCTS

2.1 POLYMER OVERLAY MATERIALS

A. Thin Bonded Polymer bridge deck overlay system using either an Epoxy-Urethane (Type 1) co-polymer or modified Epoxy (Type 2) polymer as specified on the plan or detail sheets, which includes all materials, surface preparation, application of a pretreatment for crack filling and bonding, and two coats of a polymer resin broadcast with a high wear, high skid aggregate that chemically cures to provide an impervious wearing surface.

Table 1

PHYSICAL PROPERTIES OF THE POLYMER OVERLAY SYSTEM	
Property	Value
Compressive Strength, min. psi	7,000
Tensile Strength, min. psi	2,500
Tensile Elongation, percent min.	35 ±5
Water Absorption, percent by wt. Max.	0.20
Shore D Hardness, 77°F min.	65 ±5
Gel Time, minutes	22-31
Abrasion Resistance, oz., max.	0.003
Adhesion to Concrete	100% failure in concrete
Flexural Creep: Total Movement in 7 days	.0065 inches minimum
Flexural Yield Strength, min. psi	5,000
Percent Solids	100

1. The cured epoxy-urethane system conforms to a load bearing capacity of retaining 85 percent of its original load bearing strength at (tensile strength) as 20 percent strain using ASTM D 638.
2. Type 1 – Epoxy-Urethane Co-Polymer:
   a. Provide Polymer resins consisting of a blend of epoxy and urethane materials that meet the physical requirements outlined in other parts of this Section.
   b. The polymer overlay is to be free of any fillers, volatile solvents, and the use of external/conventional flexiblizers is not permitted.
   c. The use of metered mixing equipment as outlined in other parts of this Section is required with the use of this material.
   d. In general, the use of a Type 1 polymer, with equipment, is intended for high wear conditions and rapid construction schedules, and is acceptable for use on all bridge deck environments.

3. Type 2 – Modified Epoxy Polymer:
   a. Provide Polymer resins consisting of modified epoxy materials that meet the physical requirements outlined in other parts of this Section.
   b. Use of additives, fillers, volatile solvents, and flexiblizers to modify the physical properties of the epoxy to meet physical requirements are acceptable.
   c. Use of metered mixing equipment as outlined in other parts of this Section is NOT required with the use of this material but is highly recommended.
   d. Limit the use of a Type 2 polymer to low wear conditions, and moderate construction schedules.
   e. A Type 1 (epoxy-urethane) polymer may be substituted for the Type 2 polymer for projects specifying a Type 2 (Modified Epoxy) polymer.
4. The modulus of the cured polymer system complies with the requirements of Table 2, using a variable temperature Dynamic Mechanical Analysis (DMA) at a frequency of 1 HZ with a 0.3 percent strain using ASTM D 4065.

Table 2

VISCO-ELASTIC PROPERTIES OF THE POLYMER OVERLAY SYSTEM		
TEMPERATURE	**STORAGE MODULUS Psi**	**LOSS MODULUS psi**
14°F	$1.45X10^5$	$8.70X10^3$
68°F	$1.01X10^5$	$1.30X10^4$
122°F	$5.80X10^3$	$4.35X10^3$
140°F	$1.45X10^3$	$1.01X10^3$
158°F	$8.70X10^2$	$2.90X10^2$

B. Steel Shot Blast recommended by Manufacturer.

C. Pretreatment and Crack Filler to comply with the physical properties in Table 1.

Table 3

PHYSICAL PROPERTIES OF THE PRETREATMENT SYSTEM	
Property	**Value**
Compressive Strength, min. psi	5,500 – 6,000
Tensile Strength, min. psi	3,100 – 3,400
Tensile Elongation, percent min.	35 ±5
Water Absorption, percent by wt. Max.	<0.10
Shore D Hardness, 77°F min.	70 ±5
Gel Time, minutes	48-52 (7 oz.)
Adhesion to Concrete	100% failure in concrete
Surface tension	Less than 0.0012 pounds/in^3
Percent Solids	100

D. Material Requirements: Meet the properties specified in the tables of this Section and other sections of this specification, and also meet the following correspondence tests for quality control:

1. Compressive Strength: Refer to ASTM C 109
   a. Thoroughly mix the two components of the resin in their appropriate ratios.
   b. Add two volumes of graded silica sand to one volume of mixed resin. Refer to ASTM C 778.
   c. Prepare the samples and cure for 7 days at 73° ±4°F. Refer to ASTM C 109.
2. Tensile Strength and Elongation:
   a. Cure samples at 73°F ±4°F and 50 ±5 percent relative humidity. Refer to ASTM D 638 for specimen Type I or Type II.
   b. Speed of testing: 0.5 inch/min.
3. Water Absorption:
   a. Prepare sample specimens and cure at 73°F ±4°F and 50 ±5 percent relative humidity. Refer to ASTM D 570 4.1.
   b. Perform tests as per Section 6.1 ASTM D 570
4. Shore D Hardness:
   a. Prepare specimen per ASTM D 570 Section 4.1 and cure at 73°F ±4°F. Refer to ASTM D 2240.
5. Gel Time: Determine gel time using the following procedure:
   a. Measure 4 oz. of Part A and 2 oz. of Part B each at 77°F, into an unwaxed paper cup and record the time and mix immediately
   b. Pour 3.5 oz. of this mixture into a 6 oz. unwaxed paper cup and placed on a wooden bench top.

c. Probe the mixture every 2 minutes with a small stick until a small ball forms in the center of the container starting 20 minutes from the time recorded above.
d. Consider the gel time as the total time, including mixing, required for the ball to form.
e. Perform the test in a room or enclosed area maintained at 77°F ±4°F and 50 ±5 percent relative humidity.

6. Abrasion Resistance: Tests to be done using a CS-17 wheel and a 2.2 pound load for 1,000 cycles. Refer to ASTM C 501.
7. Adhesion to Concrete: ACI-503-R, Pull Out Test.
8. Flexural Creep: California Test Method 419.
9. Flexural Yield Strength: ASTM D 790.
10. Surface Tension: ASTM D 971.

E. Aggregate

1. Non-friable, non-polishing, clean, and free of surface moisture.
2. Proven record of durability in this type of application.
3. 100 percent of the aggregate has at least one mechanically fractured face for materials being retained on the #10 sieve.
4. Thoroughly washed, kiln dried to maximum moisture content of 0.2 percent by weight per ASTM C 566.
5. Washington Stone is recommended.
6. Use alternate aggregates with Manufacturer's and Engineer's approval.
7. Meet the physical properties of Table 4 and Table 5:

Table 4

GLACIAL GRAVEL AGGREGATE PROPERTIES (BASALT QUARTZITE GRANITE)	
Properties/Materials	**% by Weight**
$Si0_2$	75.03
Al_2O_3	11.49
Fe_2O_3	3.57
CaO	2.84
MgO	1.59
SO_3	0.08
Na_2O	2.58
K_2O	0.99
Combined Alkali	3.20
Ignition Loss	1.72
Mohs Scale Hardness	6.50
ASTM 566 (water absorption)	0.2%

Table 5

AGGREGATE GRADATION	
Sieve Size	Percent Passing
0.187 inch; No.6	100
0.078 inch; No.10	10 – 35
0.033 inch; No.20	0 – 10

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Pothole Patching
   1. Refer to Section 03934 for concrete removal for pothole patching.
   2. Repair any minor deck surface potholes prior to installation of the polymer system using a cementitious patching material that meets other specifications and is compatible with the polymer system being used.
   3. Use polymer patching materials for potholes less than 2 inches deep and according to the Manufacturer's and Engineer's recommendations.
   4. Include any costs associated with the surface defects and pothole repairs less than 1 inch in depth in the Bid Item for the Polymer Overlay System.

B. Shot-Blasting
   1. Clean the entire concrete deck surface with steel shot blast to remove any oil, dirt, rubber, or other materials that may be detrimental to the polymer overlay bonding and curing according to the Manufacturer recommendations. Refer to ASTM D 4285.

C. Curbs
   1. Sandblasting equipment or mechanical grinders are permitted with approval of the Manufacturer and Engineer in areas that cannot be reached with the steel shot-blasting.

D. Traffic
   1. Do not allow traffic on any portion of the deck that has been shot-blasted.
   2. Overlay equipment will be allowed on cleaned surfaces with Manufacturer's supervision.

E. Weather
   1. All treated surfaces are to be dry at the time of application.

2. Do not apply the polymer overlay system when it has rained within 24 hours or is expected to rain within 8 hours.
3. Moisture content in the concrete substrate is not to exceed 4.5 percent when measured by an electronic meter.
4. The minimum recommended temperature is 50°F and increasing.

F. Surfacing Window
1. Do not apply polymer overlays before April 15, or after September 30.

3.2 APPLICATION

A. Check the Concrete Surface
1. Clean the concrete surface and apply a two-component pretreatment and Polymer Overlay Systems to the bridge deck to fill minor cracks and increase the bond strength between the overlay and the deck surfaces according to the Manufacturer's specifications.

B. Use Metered Mixing Equipment for Type 1 Polymers (optional for Type 2 Polymers)
1. Use special equipment capable of metering, mixing and distributing the polymer.
2. Use owner operated machinery that is approved by the polymer Manufacturer.
3. Use an application machine that features positive displacement volumetric metering pumps controlled by a hydraulic power unit.
4. Store components in temperature controlled reservoirs capable of maintaining 100°F ±10°F to insure optimum mixing.
5. Check mixing ratio at the pump outlets as well as cycle counting capabilities to monitor output on standard features.
6. Use motionless in-line mixing so as to not overly shear the material or entrap air in the mix.
7. Maximize material working time by mixing it immediately before dispensing.

C. Verify the Thickness of Individual Layers
1. Manufacture recommends the number of layers and the application rates of the liquid in the various layers in order to achieve a minimum overlay thickness of 0.375 inch.

D. First Layer

1. Manually or mechanically measure and mix the components and evenly distribute the liquid on the clean, dry deck surface at the rate recommended by the Manufacturer.
2. Wet the entire deck surface and allow 1-2 hours for the liquid to achieve full depth penetration into cracks as well as adequately encapsulate any steel grid.
3. Evenly broadcast medium size coarse silica sand after the liquid is allowed to penetrate and apply subsequent application after 8-12 hours.

E. Second Layer

1. Completely remove excess or loose aggregate from the previous coat by vacuum or with compressed air prior to the application.
2. Mix the components with the mechanical application equipment and evenly distribute the liquid on the clean, dry deck surface at the rate recommended by the Manufacturer.

F. Time Limits For Aggregate

1. Use the following maximum time allowed between the first and second coat of liquid before broadcasting the aggregate:

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

G. Broadcasting Aggregate

1. Use truck-mounted equipment capable of dispensing the aggregate onto the deck in a uniform manner as directed or approved by the Manufacturer.
2. Broadcast the aggregate to cover the surface so that no wet spots appear and before the polymer begins to gel.
3. Drop the aggregate vertically so the level of the liquid is not disturbed.
4. Broadcast the aggregate in the first and second layers of the liquid according to Table 4 and Table 5 to saturate until no wet spots remain.

H. Remove Excess Aggregate

1. Remove all loose and excess aggregate after the overlay has hardened and before applying subsequent coats using a power vacuum or other method.

I. Longitudinal Joints in the Overlay
   1. Stagger and overlap joints between successive coats so that no ridges appear between two adjacent lanes.

J. Traffic
   1. Allow traffic on the final layer or in between layers after the resin has cured as determined by the Manufacturer and after removal of all excess and loose aggregate.

K. Job Site Material Storage
   1. Store on the job site in a dry, weather protected facility away from moisture and maintain the material within the temperature range of 50-100 degrees F or as per Manufacturer's recommendations, during transport to the job site and in the application machine tanks.

L. Handling Liquid Materials on the Job
   1. Provide protective gloves, clothing, boots, and goggles to workers and inspectors directly exposed to the material.
   2. Provide product safety data sheets to all workers and inspectors as obtained from the Manufacturer.

M. Aggregate
   1. Store all aggregate in a dry, moisture-free atmosphere.
   2. Fully protect the aggregate from any contaminants on the job site and stored to not be exposed to rain or other moisture sources.

3.3 QUALITY CONTROL

A. Technical Support Representative:
   1. Manufacturer's representative is on the job site at all times and may consult with the Engineer to suspend any item of work that is suspect and does not meet the requirements of this Section.
   2. Work may resume only after the Manufacturer's representative and the Engineer are satisfied that the Contractor has taken appropriate remedial action.

B. Prior Performance:
   1. The selected material must have a satisfactory performance in Utah or at least 2-years from the time of placement.
   2. Products without a 2-year prior satisfactory performance will be considered as experimental and will only be considered for use with the approval of the Engineer after the award of the contract. Do not use for bidding purposes.

C. Packing Requirement:
   1. Pack all materials in strong, substantial containers.

2. 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 contained therein

END OF SECTION

SECTION 03390

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete curing materials and methods.

1.2 REALTED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 148: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

B. AASHTO LRFD Bridge Construction Specifications

C. ASTM C 1315: Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide manufacturer's product data, specifications, and recommended installation instructions.

PART 2 PRODUCTS

2.1 CURING COMPOUND FOR STRUCTURAL AND ARCHITECTURAL CONCRETE

A. Refer to AASHTO M 148, Type I D, Class A.

2.2 CURING COMPOUND FOR PORTLAND CEMENT CONCRETE PAVEMENT

A. Refer to AASHTO M 148, Type 2, Class A.

2.3 CURING COMPOUND FOR LEAN CONCRETE BASE COURSE

A. Use a curing compound with a wax base.

B. Refer to AASHTO M 148, Type 2, Class A.

2.4 CURING COMPOUND FOR CONCRETE BARRIER

A. Refer to ASTM C 1315, Type 1, Class A.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify concrete surfaces are ready for curing.
   1. Complete all patching or surface finishing before applying compound.

B. Follow product manufacturer's recommendations for preparing surfaces.

C. Keep surfaces moist until the curing compound is applied.

D. Do not dilute or alter the compound.

3.2 CURE STRUCTURES

A. Bridge Decks and Approach Slabs.
   1. Apply membrane-curing compound at the manufacturer's recommended rate 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.
   2. Apply membrane-curing compound at a uniform rate of 100 ft^2/gal.
   3. Work bridge to follow immediately after the finishing machine to allow application of the curing compound while the concrete is still plastic.
   4. Cover bridge decks, approach slabs, curbs, and parapet walls with material that retains moisture and does not prevent evaporation, such as cotton or burlap mats as soon as the concrete is sufficiently set to support the materials.
      a. Secure the cotton or burlap mats to prevent wind or other forces from removing them.
      b. Do not damage the finish.
   5. Keep entire concrete damp continuously for ten days after placement. Do not erode or damage the surface.

B. Other newly placed concrete: Use membrane-curing compound method.
   1. Keep surfaces moist until the curing compound is applied.
   2. Complete all patching or surface finishing before applying compound.
   3. Warm chilled compound that is too viscous to a maximum of 90 degrees F.
   4. Apply curing compound immediately after finishing operations are completed.
   5. Spray the entire surface of the concrete with a membrane curing compound at a uniform rate of 100 ft^2/gal.
   6. Immediately re-spray any portion damaged before the ten-day curing expires.

3.3 CURE CURB, GUTTER, FLATWORK, SIDEWALK, DRIVEWAY, AND OTHER CONCRETE ITEMS (CONCRETE SLOPE PROTECTION)

A. Refer to this Section, article 3.2, paragraph B.

3.4 CURE PRESTRESSED CONCRETE

A. Cure following this Section, article 3.2, or article 3.10, until concrete has reached a strength of 4,000 psi or as designated on the plans.

3.5 CURE PRECAST CONCRETE BARRIER

A. Cure exposed surfaces immediately after finishing operations are completed.
   1. Apply the curing compound at a rate of 100 ft^2/gal.

B. Broom clean the surface of the barrier and apply two coats of curing compound after removing form.
   1. Apply the first coat at a rate of 100 ft^2/gal.
   2. Allow the first coat to dry thoroughly before applying the second coat.
   3. Apply the second coat at a rate of 200 ft^2/gal.

C. Immediately repair any damage to the compound film occurring until seven days after the initial application at no additional cost to Department.

3.6 CURE CAST-IN-PLACE CONCRETE BARRIER

A. Cure immediately after finishing operations are complete.

B. Apply two coats of curing compound following this Section, article 3.5.

C. Immediately repair any damage to the compound film occurring until seven days after the initial application at no additional cost to Department.

3.7 CURE PRECAST NOISE WALL

A. Apply curing compound to all exposed surfaces immediately after finishing and when forms are removed.
   1. Apply curing compound at a uniform rate of 100 ft^2/gal.

B. Exposed aggregate finishes.
   1. Cover surface of exposed aggregate noise wall panels with a moisture barrier or membrane immediately after initial finishing operations are completed.
   2. Leave cover in place until final finishing operations (exposed aggregate) are performed.
   3. Immediately apply curing compound upon removal of cover and completion of final finishing operations.
   4. Apply curing compound at a uniform rate of 100 ft^2/gal.

C. Immediately repair any damage to the compound film occurring until seven days after the initial application at no additional cost to Department.

3.8 CURE LEAN CONCRETE BASE COURSE

A. Apply curing compound after finishing operations are complete.
   1. Spray entire exposed area (top and sides) at a rate of 200 ft^2/gal.
   2. Hand spray on small areas and areas inaccessible to mechanical spraying equipment.
   3. Provide complete coverage with curing compound at edges, corners, sides, and rough spots.

B. Damage to the film of curing compound occurring within 72 hours of application must be repaired immediately at no additional cost to Department.

3.9 CURE PORTLAND CEMENT CONCRETE PAVEMENT

A. Apply curing compound according to manufacturer's recommendations.

B. Thoroughly mix the compound and uniformly disperse the pigment before and during application.

C. Apply compound to the entire pavement surface and exposed edges immediately after completing finishing operations:
   1. Apply the 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 ft^2/gal.
3. Allow at least 30 minutes between applications.
4. Hand spray small and irregular areas and areas inaccessible to mechanical spraying equipment.

D. Stop paving operations if the compound application behind the paving machine is delayed until the problem is resolved.
1. Keep the pavement moist with water until the compound application process is resumed.
2. Apply the water in a fog-mist spray without damaging the pavement surface texture.

E. Immediately repair any damage to the compound film occurring until seven days after the initial application at no additional cost to Department.

3.10 STEAM OR RADIANT HEAT CURING

A. Steam or radiant heat curing may only be used for products manufactured in an established plant.

B. Provide a complete steam or radiant heat curing system approved by the Engineer, including 24 hour temperature control and monitoring devices, and a suitable enclosure to contain live steam and minimize moisture and heat losses.

C. Comply with the requirements of the AASHTO LRFD Bridge Construction Specifications, section 8.11.
1. Do not apply heat until the concrete has set. Wait four to six hours if retarders are used. Wait two to four hours if no retarders are used.
2. Heat may be applied to maintain a minimum temperature of 50 degrees F within the curing enclosure while waiting for the concrete to set.
3. Maintain 100 percent relative humidity in the curing enclosure.
4. Do not apply heat directly on the concrete or cause localized high temperatures.
5. Increase the ambient air temperature at a rate not to exceed a 40 degrees F per hour until a temperature range of 140 degrees to a maximum160 degrees F is reached when applying heat.
6. Maintain the temperature range until the concrete has reached the specified strength.
7. Decrease the ambient air temperature at a rate not to exceed a 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.

8. Transfer stressing force to the concrete immediately after heat curing has ceased for prestressed members.

END OF SECTION

SECTION 03392

PENETRATING CONCRETE SEALER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for applying protective penetrating concrete sealer.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO T 242: Standard Test Method for Frictional Properties of Paved Surfaces Using a Full-Scale Tire

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer's product data, specifications, and recommended installation instructions.

B. Certification of a minimum Friction Number of 40 for at least 90 percent of friction numbers. Refer to AASHTO T 242.
   1. Applies only to traveled way surfaces where the plans require sealer.

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

PART 3 EXECUTION

3.1 PREPARATION

A. Keep surfaces dry and free of laitance, dirt, dust, paint, grease, oil, rust, and other contaminants.

B. Remove any curing compound from the surface of the concrete before applying penetrating sealer.

C. Use one of the following cleaning methods:
   1. Hydroblasting - 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.

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. Application Drying Time: Select a sealer with maximum drying time of 1½ hours.

C. Do not apply sealer to portland cement concrete pavement (PCCP). Meet the minimum Friction Number of 40 for at least 90 percent of friction numbers when plans specify application to other traveled way surfaces such as approach slabs, bridge decks, etc. Refer to AASHTO T 242.

END OF SECTION

SECTION 03412

PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pretensioning, fabricating, curing, transporting, storing, and erecting prestressed concrete members.

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

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. AASHTO LRFD Bridge Construction Specifications

G. ASTM C 150: Portland Cement

H. American Institute of Steel Construction (AISC)

I. Precast/Prestressed Concrete Institute (PCI)

J. US Military Specifications

K. UDOT Quality Management Plans

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Certifications:
   1. Certification stating the manufacturer's minimum guaranteed ultimate tensile strength for each sample of prestressing steel.
   2. AISC Simple Steel Bridge Structures (SBR) Certification for structural steel fabrication.
   3. The certified calibration chart required by this Section, article 3.2 A.

B. Prestressing Steel:
   1. Furnish three 6 ft long strand samples from each heat or lot that will be used on the project, at no additional cost to the Department.
   2. Testing may require 14 calendar days after the date of receipt.

C. Submit five sets of working shop drawings of the prestressing system sufficiently before the start of the affected work to allow time for review by the Engineer and correction by the Contractor without delaying the work.
   1. Show complete details and substantiating calculations of the method, materials, and equipment to be used in the prestressing operations, including any additions or rearrangement of reinforcing steel and any revision in concrete dimensions from that shown on the plans.
   2. Outline the method and sequence of stressing. Include complete specifications and details of the prestressing steel, working stresses, and all other data pertaining to the prestressing operation. Include the proposed arrangement of the prestressing steel in the members. Include the cutting or release pattern.
   3. Do not begin fabrication or installation of prestressing material before approval of the drawings.
   4. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.
   5. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days for the project. This is reduced to 7 days when drawings are submitted electronically. This right applies each time the drawings are submitted.

D. Erection Plan: Submit an erection plan 10 days before beginning erection of prestressed concrete members for documentation purposes only. The Engineer will not approve the erection Plan. 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 erection schedule and sequence, crane location, crane capacities, location of lifting points on the bridge members, member weights, and any other assumed loads during progressive stages of construction.
3. Complete details for all anticipated phases and conditions during erection.
4. Minimum number and arrangement of primary members, secondary members, connections, etc. 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 3.7.
6. The erection plan and supporting documents will be approved, signed, and sealed by a Professional Engineer licensed in the State of Utah. The Professional Engineer must approve all changes to the erection plan before implementation.
7. UDOT prefers a PCI Certified Erector.

1.6 ACCEPTANCE

A. Girders may be accepted at a reduced price when the average compressive strength is at least 94 percent of the specified strength.

1. Price reduction factor is as follows:

   Price Reduction Factor = 1.00-0.30 $\left\{ \frac{f'c - AVG}{0.06 f'c} \right\}^2$

   Where: *f'c* = specified 28-day 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 prestressed concrete member by the price reduction factor.

PART 2 PRODUCTS

2.1 CONCRETE

A. Portland Cement: Type I or Type II, or Type III, low alkali.

B. Type III cement: conform to ASTM C 150, Table 2, for moderate sulfate resistance.

C. Class AA(AE) concrete according to Section 03055, except as modified below:
   1. Air entraining admixture to provide 5.0 to 7.5 percent entrained air.
   2. Minimum compressive strength 5,000 psi at 28 days, or as specified in the plans.
   3. Minimum compressive strength for transfer of prestressing force is 4,000 psi or as specified in the plans.
   4. Maximum slump is 7 inches.
   5. Use coarse aggregate gradation meeting the ¾ inch No. 4 sieve per Section 03055.
   6. Minimum cementitious content must be 611 lb/yd^3.
   7. Water-Cementitious ratio must not exceed 0.44 by weight including free-water in the aggregates.

D. Girders: Reject if the average 28-day compressive strength of representative cylinders is less than 94 percent of the specified strength. Core tests are not permitted for compressive strength tests.

2.2 PRESTRESSING STEEL

A. Meet AASHTO M 203. Use ½ inch or 0.6 inch diameter, Grade 270.

2.3 REINFORCING STEEL

A. Use coated or corrosion-resistant reinforcing steel as specified in 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. Threaded Rods: AASHTO M 270, Grade 36.

B. Carbon-Steel Shapes and Plates: AASHTO M 270, Grade 36.

C. Carbon-Steel Headed Studs: AASHTO M 169. Automatic end welded.

D. Welding: AASHTO/AWS D1.5.

E. Galvanize all structural steel items permanently cast into concrete per AASHTO M 111.

2.7 QUALITY ASSURANCE

A. Use a Department prequalified supplier of precast concrete products according to the UDOT Quality Management Plan: Precast/Prestressed Concrete Structures.

PART 3 EXECUTION

3.1 FABRICATION

A. Comply with camber and dimensional tolerances of PCI MNL 135.

B. Fabricate structural steel per Section 05120. Unless otherwise specified, structural steel for prestressed concrete members requires AISC Simple Steel Bridge Structures (SBR) Certification.

3.2 PREPARATION

A. All equipment used to stress tendons must be accurate including jacks, pressure gauges, load cells.
   1. Calibrate each jack and its gauge as a unit with the cylinder extension in the final jacking force position.
   2. Furnish a certified calibration chart.

B. Calibrate the load cell and provide an indicator to determine the prestressing force in the tendon. The range of the load cell must be such that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking stress.

C. The prestressing force may be tested by Engineer.

D. 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.

3.3 PRESTRESSING STEEL

A. 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.

B. Protect against physical damage and corrosion during shipping, handling, and storing.

C. Replace prestressing steel that has damage, loose rust, pitting, or serious corrosion. Slight rusting that occurs after placement in the beds is acceptable if it does not cause visible pits.

D. Do not oil or grease prestressing strand.

3.4 PRETENSIONING

A. Install and support testing equipment at the prestressing tendons and remove the testing equipment after the testing is completed.

B. Tension all prestressing steel with hydraulic jacks so that the force in the prestressing steel is not less than the value shown.

C. Do not allow the initial stress to exceed 70 percent of the specified minimum ultimate tensile strength.

D. Average working stress in the prestressing steel must not exceed 60 percent of the specified minimum ultimate tensile strength of the prestressing steel unless otherwise shown.

E. Maximum temporary tensile stress (jacking stress) in prestressing steel must not exceed 75 percent of the specified minimum ultimate tensile strength.

F. Working force and working stress are the force and stress remaining in the prestressing steel after all losses peculiar to prestressing have either taken place or been provided for. These losses include concrete creep and shrinkage, concrete elastic compression, steel creep, and anchorage take ups.

G. Anchor the prestressing steel at stresses (initial stress) that result in the ultimate retention of working forces not less than those shown.

H. The stress loss in pretensioned, prestressing steel due to creep and concrete shrinkage, steel creep, and concrete elastic compression is as shown on the plans.

I. 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. Use methods and equipment acceptable to Engineer.

J. Re-tension all strands that show a loss of prestress in excess of three percent.

K. 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. Do not allow the jacking stress to exceed 75 percent of the specified minimum ultimate tensile strength.

L. Maintain a minimum lateral eccentricity of prestress when cutting and releasing prestressing steel in pretensioned members. Submit a cutting or release pattern to the Engineer for prior approval.

M. Do not cut or release prestressing steel in pretensioned members until the concrete in the member has attained a compressive strength of not less than the value shown on the plans or 4,000 psi, whichever is the greater.

N. Cut off all pretensioned, prestressing steel flush with the end of the member except when otherwise shown in the plans. Clean and paint the exposed strand ends and a 1-inch strip of adjoining concrete. Alternatively, cut the strands a minimum of 1 inch back from the girder end, fill the recess with grout, and finish flush with the girder ends.
   1. Use a wire brush or abrasive blast cleaning to remove all dirt and residue not firmly bonded to the metal or concrete surfaces.
   2. Cover the surfaces with a thick application of zinc-rich paint. Thoroughly mix the paint at the time of application and work it into any voids in the strands.
   3. Apply two applications to surfaces that are not covered by concrete or mortar.

3.5 PLACE CONCRETE

A. Do not place concrete into forms until the reinforcement and prestressing steel has been Department inspected and approved.

B. Vibrate the concrete internally, externally, or both.

C. Avoid displacing reinforcing steel or strands.

D. Finish surfaces of cast-in-place concrete that will later be cast against the top surfaces of precast beams or girders to a coarse texture by brooming with a stiff, coarse broom. Clean such surfaces of laitance or other foreign material by sandblasting before shipping.

3.6 LIMITATIONS

A. Refer to Section 03310 for hot and cold weather limitations.

B. Remove the prestressing member side forms within one to two days provided satisfactory arrangement has been made for curing the concrete.

C. Adequately support the members at all times to prevent dead load bending until after the anchorages for pretensioned members have been released.

3.7 CURE

A. Cure as specified in Section 03390.

3.8 DELIVERY, STORAGE, AND HANDLING

A. Store units with adequate dunnage and bracing. Secure and protect units from movement and prevent cracking, distortion, warping, contact with soil, staining, and other physical damage.
   1. Store units with dunnage across full width of each bearing point unless otherwise specified.
   2. Place stored units so identification marks are clearly visible and units can be inspected.

B. Transport precast girders in an upright position. Support the girders during transportation in approximately the same points they will be supported when installed.

C. Prevent cracking or damaging precast units during storage, hoisting, and handling.

D. Take appropriate measures to prevent girder camber from exceeding the tolerances specified in this Section, article 3.1 until deck is placed.

E. Installation of lifting devices is permitted provided that any portion of the devices that protrudes above the top of the girder is removed when no longer needed.

F. Do not ship prestressed concrete members until tests on concrete cylinders manufactured from the same concrete and cured under the same conditions as the girders indicate that the concrete of the particular member has attained a compressive strength equal to the specified design compressive strength or for seven days after concrete placement, whichever is longer.

3.9 ERECTION

A. Maintain responsibility for all aspects of girder erection during all stages of construction, including the protection of prestressed concrete members, the workers, and the traveling public.

B. Erect all prestressed concrete members in compliance with the erection plan. Erect girders in a manner that prevents damage to all elements of the structure.

C. Temporarily support, anchor, and brace all erected superstructure members as necessary for stability and to resist wind or other loads until they are permanently secured to the structure. Support, anchor, and brace all superstructure members as detailed in the erection plan before allowing traffic under the bridge.

D. Design temporary supports and falsework according to the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3 "Temporary Works."

E. Accurately assemble all parts as specified in the contract documents or erection drawings. Follow any match-marks.

F. Carefully handle materials so that no parts will be cracked, chipped, broken, or otherwise damaged.

G. Use lifting devices in a manner that does not cause damaging, bending, or torsional forces.

H. Clean bearing surfaces and surfaces that will be in permanent contact before the members are erected.

I. Do not open traffic under a partially-erected bridge superstructure, unless allowed in the erection plan or approved by the Professional Engineer who approved, signed, and sealed the erection plan.

END OF SECTION

SECTION 03575

FLOWABLE FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for placing flowable fill.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

1.3 REFERENCES

A. AASHTO M 154: Air-Entraining Admixtures for Concrete

B. AASHTO M 194: Chemical Admixture for Concrete

C. ASTM D 4832: Preparation and Testing of Controlled Low Strength Material (CLSM) Test

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Batch Proportions: Submit to Engineer seven days before placement.

B. Trial Batch:
   1. Submit certified test results or conduct laboratory trial batch to verify strength prior to placement.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement: Refer to Section 03055 Portland Cement Concrete.

B. Pozzolan: Refer to Section 03055 Portland Cement Concrete.

C. Sand.

D. Coarse aggregate: Determine a suitable aggregate size and gradation for the intended application.

E. Admixtures:
   1. Water reducers and set accelerators: AASHTO M 194.
   2. Air entrainment: AASHTO M 154.

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. ASTM D 4832.
   2. Maximum strength: 150 psi. ASTM D 4832.
   3. Slump: 5 inches to 10 inches.

B. Determine a suitable aggregate size and gradation for the intended application.

END OF SECTION

SECTION 03605

APPROACH SLAB JACKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raising the approach slabs by pumping cement grout underneath.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

1.6 CERTIFICATION

A. Provide compliance certifications for the mix design materials conforming to the requirements of the specified specifications.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Furnish all equipment necessary to perform this work.

B. Grout device:
   1. Cement injection pump and a high-speed colloidal mixing machine.
   2. Colloidal mixing machine that operates at a minimum speed of 1,200 rpm and consists of a rotor operating in close proximity to a strator creating a high shearing action and subsequent pressure release to make a homogeneous mixture.

C. Provide water storage tank and a pump to deliver water to the grout mixer.

D. Furnish an air compressor and rock drills or other device capable of drilling the grout injection holes through the approach slab and any base material, if necessary. Equipment must be in good condition.

2.2 DRY MIX DESIGN

A. Use the standard mix design for jacking and grouting as follows:
   1. One part (by volume) portland cement type I or II.
   2. Three parts (by volume) pozzolan (natural or artificial).

B. Do not deviate from the dry mix proportions of portland cement and pozzolan unless approved by the Engineer. The water content may be varied as required for the local conditions.

C. May add an approved liquefier, water reducing agent, or both. The Engineer approves the proportions.

PART 3 EXECUTION

3.1 PREPARATION

A. Measure the dry cement and pozzolan accurately in cubic yards whether available in bulk or packaged.

B. Batch water through a meter or scale.

3.2 DRILL

A. Drill a minimum of four evenly spaced holes into each half of every approach slab where required to obtain uniform placement underneath the approach slab. Drill holes that are vertical and not out-of-round.

3.3 PUMP

A. Pump in a pattern and in the amount required to completely fill the voids underneath the slab. Raise the approach slabs to within plus or minus $^{3}/_{16}$ inch from a string line grade.

B. Remove pozzolan mix material from the drill holes at the completion of the pumping operation. Clean the circumference of the hole and seal the hole with stiff sand and cement grout or an approved fast setting cement mortar.

END OF SECTION

SECTION 03924

STRUCTURAL CONCRETE REPAIR AND SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for the repair of columns, pedestals, bent and pier caps, diaphragms, wingwalls, abutment backwalls, beam ends and parapets.

B. Sealing columns, pedestals, bent and pier caps, diaphragms, wingwalls, abutment backwalls, beam ends and parapets.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03310: Structural Concrete

C. Section 03392: Penetrating Concrete Sealer

1.3 REFERENCES

A. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives

B. AASHTO T 106: Standard Method of Test for Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)

C. AASHTO T 161: Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing

D. ASTM C 882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

E. ASTM C 1042: Standard Test Method for Bond Strength of Latex Systems Used with Concrete by Slant Shear

F. ASTM D 4285: Standard Test Method for 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 for all materials.

B. Provide evidence that epoxy injection equipment operators have at least the two years experience required in the methods and materials of the selected system for application of epoxy injection per this Section, Article 3.3 at the request of the Engineer.

C. Supply girder jacking engineering calculations that are signed and sealed by a Professional Engineer licensed in the State of Utah when it is required for pedestal repair.

1.6 ACCEPTANCE

A. For Delamination Repair:
   1. Rebuild the areas to original shape, ± ⅛ inch.
   2. Remove and repair if the patching fails to bond. Department does not allow additional compensation for repair of failed patches.

B. For Epoxy Injection:
   1. Penetration of 95 percent of all cracks from $^{1}/_{64}$ inch to ¼ inch wide is required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Patching Concrete:
   1. Use only products recommended for vertical application by the manufacturer. Obtain Engineer's approval before use.
   2. Use a product that meets AASHTO T 106 and T 161, and meets ASTM C 882 or C 1042.

B. Repair Concrete:
   1. Portland Cement Concrete: Class AA(AE). Refer to Section 03055.
   2. Aggregate: ¾ inch maximum.

C. Substrate Coating: Use a bonding agent or primer recommended by the patching concrete manufacturer.

D. Epoxy Resin Adhesive
   1. Use an appropriate Epoxy Resin Adhesive meeting AASHTO M 235.
      a. Select Type and Class for the application.

E. Epoxy injection:
   1. Use only products for which vertical crack injection is recommended by the manufacturer.
   2. Use appropriate cap seal material recommended by the particular epoxy manufacturer.
   3. Deliver the materials in unopened packages with labels clearly indicating the following:
      a. Name of Manufacturer
      b. Manufacturer's product name or product number
      c. Manufacturer's lot number
      d. Mix ratio
      e. SPI hazardous material rating and appropriate warnings for handling
      f. Surface Sealing Material: Refer to 03392.

2.2 EQUIPMENT REQUIREMENTS

A. Repair Concrete Mixer:
   1. Use an approved type of small mixer to batch out the repair concrete when specifically approved by the Engineer.

B. Epoxy Injection:
   1. 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 material 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 A and B reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

C. Sand blaster:
   1. Supply a Sand blaster that meets the requirements in ASTM D 4285 when required.

PART 3 EXECUTION

3.1 PREPARATION FOR STRUCTURAL CONCRETE 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. Preparation for Delamination Repair:
   1. Make ½ inch deep saw cuts in the sound concrete surrounding the damaged areas.
   2. Remove all damaged, shattered, and delaminated concrete.
   3. Remove all loose materials by dry sweeping.
   4. Sandblast clean all exposed reinforcing steel and concrete surfaces before placing new concrete. Protect in place any sound epoxy coated or galvanized rebar. Sand blast with an air compressor that meets the requirements in ASTM D 4285.
   5. Prevent sandblasting material and debris from falling into streams, pedestrian areas, traffic areas, or onto railroad tracks.
   6. Clean by blowing with clean and dry compressed air at 90 psi.
   7. Touch up the damaged epoxy coating prior to placing concrete if reinforcing steel is epoxy coated.

C. Pedestal repair:
   1. Provide jacks and all other equipment required for girder jacking when needed to complete the work and as directed by the engineer. Refer to this Section, article 1.5 for other requirements.

3.2 CRACK REPAIR

A. Repair cracks from $^{1}/_{64}$ inch to ¼ inch wide by epoxy injection and sealing.

B. Repair cracks greater than ¼ inch wide as delamination repair.

3.3 EPOXY INJECTION

A. Installers:
   1. Injection equipment operators must have at least two years experience in the methods and materials of the selected system for application of epoxy injection.
   2. Injection equipment operators must know the technical aspects of:
      a. Correct material selection and use.
      b. Equipment operation, maintenance, and troubleshooting.

B. Preparation:
1. Sandblast the concrete surfaces clean.
2. Seal cracks.
3. Provide entry ports for the epoxy injection. Space ports a maximum of 6 inches.

C. Epoxy Injection:
1. Proceed from lower to higher ports.
2. Plug the port being injected and move to a higher port when epoxy appears at a higher port.

D. Epoxy Sealing:
1. Grind flush all ports extending above the concrete surfaces.
2. Apply the sealant at the minimum application rate of 0.09 gal/yd^2.
3. Cover the entire length of the crack with epoxy sealant for at least 6 inches on both sides of the crack.
4. Mask the member so a straight vertical line is produced at the cutoff point.
5. Apply a second coat at the same application rate as soon as the first coat is dry to the touch. Follow manufacture's recommendations. Do not exceed the following times between coats:

Table 1

Time Requirements	
Hours	**Temperature (Degrees F)**
72	66
36	77
24	90

3.4 DELAMINATION REPAIR

A. Form Work.
1. Use forms and braces to place new concrete to the original dimensions.
2. Vibration is required in the forms when the area between forms and existing concrete surface will allow use of vibrators.

B. Use one type of repair concrete.

C. Placing concrete when thickness to be placed is less than or equal to 3 inches:
1. Use patching concrete.
2. Coat the cleaned concrete using the manufacturer's recommended primer.

3. Place patching concrete in layers not exceeding the manufacturer's recommended application thickness per layer.
4. Apply the surface sealer recommended by the manufacturer.
5. Consult the manufacturer's recommendations for finishing.

D. Placing concrete when thickness to be placed is greater than 3 inches:
1. Apply an epoxy-resin adhesive to the cleaned concrete surface of the repair area before placing the new concrete.
2. Place the concrete and allow it to cure following the requirements of Section 03310.
3. Sandblast the finished concrete surfaces and coat with a penetrating type epoxy sealer after the concrete has properly cured. Follow the manufacturer's procedure.

E. Finished surfaces: Provide the look of one color.

3.5 PARAPET SURFACE REPAIR

A. Remove loose and spalled concrete before sandblasting.

B. Sandblast the top and traffic face of the parapet surfaces to remove all dirt, grease, laitance, rust and corrosion before placing concrete or sealer.
1. Prevent sandblasting material and debris from falling into streams, pedestrian areas, traffic areas, or onto railroad tracks.
2. Sand blast with an air compressor that meets the requirements in ASTM D 4285.

C. Coat concrete substrate with the manufacturer's recommended primer of the particular patching concrete after sandblasting.

D. Place concrete within the manufacturer's prescribed time period after sandblasting and prime coating has been completed.

E. Patching Concrete:
1. Apply the one component, non-shrinking patching concrete uniformly to build back the original surfaces of the face and top areas of the parapets to within ± ⅛ inch of the original surface. Allow concrete to cure according to the manufacturer's recommended requirements.
2. Remove the patch completely and repair again if the patch fails to bond to the existing concrete.

F. Finishing Surfaces:
1. Provide a uniform color matching existing parapet.
2. Finish according to Section 03310. Follow manufacturer's recommendations for procedure.

G. Coating Parapet Surfaces:
   1. Allow concrete to properly cure.
   2. Sandblast all curing compound from the top and traffic face of the parapet.
   3. Coat all sandblasted surfaces with the penetrating concrete sealer following the manufacturer's recommended procedure.

H. Provide a satisfactory treatment to restore surfaces to a uniform color if wingwalls, overhanging portions of the deck, or exterior beam surfaces become stained or discolored due to water or concrete leaking from the forms.

I. Remove sandblasting materials and debris from the deck after the work is complete.

3.6 SEAL

A. Preparation for Sealing Concrete Surfaces:
   1. Sandblast the entire exposed surfaces clean of all dirt, grease, and laitance.
   2. Prevent sandblasting material and debris from falling into streams, pedestrian areas, traffic areas, or onto railroad tracks.

B. Concrete Surfaces:
   1. Coat the entire exposed surface with the penetrating concrete sealer following the manufacturer’s application procedures and recommendations. Refer to Section 03392.

END OF SECTION

SECTION 03932

CONCRETE SLOPE PROTECTION REPAIR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare and place concrete slope protection and cutoff wall where required.

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. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.

B. Federal Specifications

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Submit certificates of compliance and sealant material test results for each lot of materials supplied.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Concrete Class A(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Reinforcing Steel: Refer to Section 03211.

D. Backer Rod: Refer to Section 03211.

E. Rigid Plastic Foam: Type 9, Density of 2 lbs/ft^3.

F. Sealant Material
1. Applied cold and curable under field conditions.
2. Polyurethane based, gun grade.
3. Elastomeric, non-sag seal.
4. Bonds tightly to concrete sides and joints.
5. Physical properties when cured 21 days at 73 degrees F as follows.

Table 1

Physical Properties		
Property	**Value**	**Method**
Modulus of elasticity at 100 percent elongation	132 psi	ASTM D 412
Hardness	40 ± 5	Shore A
Elongation (at break)	450 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile strength	190 psi	ASTM D 412
Adhesive in peel	20 lbs/inch	TT-S-00230C
Adhesive in loss	0 percent	TT-S-00230C
Service range	-40 degrees F to 150 degrees F	
Initial cure, tack free (depending on temperature and humidity)	6 to 8 hours	
Final cure	5 to 8 days	
Staining characteristics	Non-staining	
Federal Specification	Type II Class A	TT-S-00120C

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 cutoff walls where required.
   2. Fill depressions with untreated base course material, grade, and compact.
   3. Firmly compact the subgrade.
   4. Thoroughly sprinkle the surface with water prior to placing the concrete. The Engineer will approve all surfaces before concrete is placed.

3.2 PLACE CONCRETE

A. Place concrete slope protection within 7 days after removing concrete slope protection. Refer to Section 03055 and Section 03310.

B. Make concrete consistency such that concrete may be placed on the slopes without deformation.

C. Complete all scoring as indicated on the plans.

D. Stop placing concrete if it is not feasible to complete the entire slope protection during one placement. Use a construction joint located in a scoring or at the junction of the slope and the abutment.

3.3 FINISH AND CURE CONCRETE

A. Use a floated surface finish. Refer to Section 03310.

B. Cure following Section 03390.

3.4 SEAL JOINTS AND CLOSURES

A. Place the backing rod and sealant when the concrete has properly cured.
   1. Concrete surfaces in the grooves must be clean and dry when backing and sealant are placed.
   2. Completely remove curing compounds, oil, grease, dirt, and any other foreign materials from concrete surfaces in the grooves by sandblasting.

B. Place the sealant with hand or power operated caulking guns after placing the backing rod.
   1. Start the placement at one side and proceed to the other side on horizontal grooves and from top to bottom on vertical grooves.
   2. Tool the sealant using a concave pointing tool with soap solution.

C. Place rigid plastic foam material (styrofoam) 1 inch thick against the surface of all structural members prior to placing the concrete slope protection.
   1. Anchor the rigid plastic foam in place with a compatible adhesive.
   2. Recess the rigid plastic foam in the joints so a groove is formed above the styrofoam filler.
   3. Fill the groove with sealant above the styrofoam so the joint is sealed over completely.
   4. Place sealant when the ambient air temperature is at least 50 degrees F and rising.

END OF SECTION

SECTION 03933

PARAPET/PARAPET END MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Methods and materials for modifying existing concrete parapet systems to:
   1. Meet current standards.
   2. 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 03211: Reinforcing Steel and Welded Wire

C. Section 03310: Structural Concrete

D. Section 03392: Penetrating Concrete Sealer

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 235: Epoxy Resin Adhesives

D. AASHTO M 270: Structural Steel for Bridges

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer's product data, specifications, and recommended installation instructions.

B. Submit a method of removal to the Engineer before removing concrete on the parapet.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete, Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Reinforcing Steel (Coated): Refer to Section 03211.

D. Connection Bar:
   1. Grade 36. Refer to AASHTO M 270.
   2. Galvanized. Refer to AASHTO M 111.

E. Guardrail Preset Anchors: Follow plans.

F. Surface Sealing Material: Refer to 03392.

G. Preformed Joint Filler: Refer to AASHTO M 213.

H. Anchoring Epoxy:
   1. Use an appropriate Epoxy Resin Adhesive meeting AASHTO M 235. Select Type and Class for the application.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate existing electric conduit, protect from damage.

B. Carefully remove existing parapet railing and brackets, and deliver to the UDOT maintenance shed designated by the Engineer.

3.2 CONCRETE REMOVAL

A. Prevent debris from falling into streams, pedestrian areas, traffic areas or railroad tracks.

B. Parapet modification to meet standards:
   1. Remove the existing parapet concrete. Prevent damage to wingwalls and deck surface.
   2. Remove loose and spalled concrete. Sandblast the removal areas.
   3. Refer to this Section, article 1.5, paragraph B.

C. Preparing 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.
   3. Remove approach slab curb between the parapet end and the approach slab end.
   4. Remove loose and spalled concrete and sandblast the removal areas.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel:
   1. Refer to the design plans for specific directions.
   2. Thoroughly clean by sandblasting remaining steel of all corrosion and adhering materials.

B. New Reinforcing Steel:
   1. Modifications: Use epoxy resin adhesive to attach rebar as indicated on the plans. Refer to AASHTO M 235.
   2. Place new coated reinforcing steel after sandblasting operations are complete.

3.4 PLACE CONCRETE

A. Refer to Section 03055 and Section 03310.

B. Clean concrete and steel surfaces. Dampen existing concrete before placing new concrete.

3.5 CONNECTION BARS

A. Modifying to meet standards: Provide two bars for each parapet end.

B. Preparing parapet end modifications: Provide two bars for each parapet end modification except where noted otherwise.

3.6 FORMS

A. Clean forms thoroughly.

B. Coat forms with a release agent that does not stain concrete or impair bonding properties of any concrete protective surface coating.

3.7 FINISH

A. Refer to Section 03310.

3.8 COAT CONCRETE SURFACES

A. Allow concrete to properly cure.

B. Sandblast the top and traffic face of the parapet of all curing compound.

C. Coat all sandblasted surfaces with the penetrating concrete sealer. Follow the manufacturer's recommended procedure.

3.9 STAIN

A. Provide a treatment to restore to a uniform color when any concrete surface of the structural members become stained.

END OF SECTION

SECTION 03934

STRUCTURAL POTHOLE PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Repair potholes and delaminated areas on bridge decks and approach slabs.

1.2 RELATED SECTIONS

A. Section 01571: Environmental Controls

B. Section 03055: Portland Cement Concrete

C. Section 03390: Concrete Curing

1.3 REFERENCES

A. AASHTO M 235: Epoxy Resin Adhesives

B. ASTM C 882: Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit a plan for handling water approved by the Engineer before the water blasting operation begins. Refer to this Section, article 3.2.

1.6 ACCEPTANCE

A. Remove and repair the patching if it fails to bond. Department does not allow additional compensation for continual repair of failed patches.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE), ¾ inch maximum aggregate. Refer to Section 03055.

B. Rapid Setting Repair Mortar: Meet the requirements in ASTM C 882

C. Epoxy Resin Adhesive:
   1. Type II.
   2. Choose class rating consistent with the application temperature.
   3. AASHTO M 235.

D. Water: Use water containing no hazardous or toxic materials.

2.2 EQUIPMENT

A. Jackhammer: 30 pound class.

B. Water Blast Equipment:
   1. Provide a complete concrete removal system capable of removing concrete to the specified depth.
   2. Equipped with a full rotation water jet. Use a water jet having an angle of impingement of 60 degrees or less as measured from the deck surface.

2.3 TEST AND CALIBRATE HYDRO-DEMOLITION EQUIPMENT

A. Demonstrate that the equipment, personnel, and method of operations are capable of producing results satisfactory to the Engineer.

B. Do not change parameters once the operation parameters of the hydro-demolition process are defined and satisfactorily demonstrated.

C. Maintain an inventory of common wear parts and replacement accessories for the equipment on the job site.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate all unsound concrete in the deck and approach slabs and mark a rectangular area surrounding each pothole in the presence of the Engineer.
   1. Refer to pothole patching plan.
   2. Remove any asphalt surfacing prior to sounding survey.

3.2 CONCRETE REMOVAL

A. Use either the jackhammer or hydro-demolition method described below.

1. Jackhammer Method:
   a. Saw Cuts: Make saw cuts 1 inch deep at the rectangular limits of the repair areas.
   b. Remove concrete using 30 pound class jackhammer.
   c. Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface. Protect any reinforcing steel encountered. Replace any reinforcing steel damaged at the contractor's expense.
   d. Pneumatic hammers heavier than 15 pound class will not be permitted for removals in areas directly below the top reinforcing steel.
   e. Remove the concrete to ½ inch below the bottom of top mat of steel if the delamination occurs at the depth of the top mat of steel.
2. Hydro-demolition Method:
   a. Remove delaminated concrete to the required depth using hydro-demolition methods. Required depth depends on the delamination depth.
   b. Provide the water necessary for the hydro-demolition operation. Use water containing no hazardous or toxic materials.
   c. Collect water and debris from the removal operations retention basins or sediment traps. Refer to Section 01571 and EN Series Standard Drawings.
      1) Use pond liners to limit the amount of water leached into the soil from retention basins at the ends of the bridge. Contain waste water, along with concrete debris from the removal operation, in holding ponds for 12 hours before discharging of the water.
      2) The ponds must be equipped with a turn-down elbow to eliminate oil or floatables from being discharged. Dispose of remaining material in the holding ponds in the proper manner.
      3) Clean all water that is returned to the stream bed of sediments and debris. Use temporary slope drains to return water to the stream. Do not allow water to run across traveled lane.

d. Use a jackhammer to remove concrete that cannot be removed with the water blast equipment.
   1) Operate jackhammer at an angle greater than 45 degrees as measured from the deck surface. Protect any reinforcing steel encountered.
   2) Pneumatic hammers heavier than 15 pound class will not be permitted for removals in areas directly below the top reinforcing steel.

B. 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. Use sandbags to limit the flow of water through the hole if necessary.
   2. Lower a rope through the hole and lift a ¾ inch thick piece of plywood large enough to cover the hole with a 2 inch overlap on all sides.
   3. Secure the plywood tightly against the bottom of the slab using ¼ inch to ½ inch threaded tie rods fastened to 2 x 4 studs at the top of the deck. Remove the forms as soon as the concrete is set and patch the hole.
   4. Use treated plywood to facilitate stripping.

3.3 BONDING CONCRETE

A. Apply an epoxy resin adhesive to the repair area to assist in bonding the fresh concrete to the hardened concrete.
   1. Apply the material according to the manufacturer's specifications.
   2. Keep the repair area clean until new concrete has been placed.

3.4 PATCHING CONCRETE

A. Sandblast clean all exposed concrete surfaces and reinforcing steel prior to placing new concrete. Place concrete within eight hours after sandblasting has been completed. Reblasting will be required if blasted rebar is left overnight.

B. Provide new rebar splices of equivalent size to existing rebars wherever a section loss greater than 50 percent occurs.

C. Place concrete and strike off level with deck surface. Cure a minimum of four days using the water method. Refer to Section 03390. Follow the manufacturer's requirements if using Rapid Setting Repair Mortar.

D. 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 streams, pedestrian areas, traffic areas, or railroad tracks.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for erecting structural metals.

1.2 RELATED SECTIONS

A. Section 05822: Bearings

B. Section 09972: Painting for Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 164: Standard Specification for High-Strength Bolts for Structural Steel Joints

C. AASHTO M 270: Standard Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

D. AASHTO M 291: Standard Specification for Carbon and Alloy Steel Nuts

E. AASHTO M 293: Standard Specification for Hardened Steel Washers

F. AASHTO LRFD Bridge Construction Specifications

G. AASHTO/AWS D1.5 Bridge Welding Code

H. ASTM F 606: Standard Specification for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets

I. ASTM F 959: Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners

J. American Institute of Steel Construction (AISC)

K. Society for Protective Coatings (SSPC)

L. UDOT Quality Management Plan

M. UDOT Steel and Concrete Construction Manual

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Manufacturer's certificate of compliance for nut proof load tests as specified. AASHTO M 291.
   1. Certificate must show corresponding lot numbers appearing on the shipping package, certification, test location, time and date, and results of all testing.
   2. Include rotational capacity and proof load test results.

B. Copy of certified mill test reports (MTR) for all fabricated structure materials, seven calendar days before fabrication, including materials manufactured outside the United States. Clearly indicate country of origin on MTR.

C. Shop Drawings: Submit five copies of shop detail drawings for all fabricated materials.
   1. Submit five sets on 11 inch x 17 inch sheets with the Department project designation data, structure number, drawing number, and sheet number in the lower right corner.
   2. All details are subject to modification or approval.
   3. Do not order materials or begin work until receiving final approval of the shop detail drawings.
   4. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.
   5. Engineer reserves the right to retain these drawings up to 14 calendar days unless they are submitted electronically in which case seven calendar days will apply, without granting an increase in the number of working days for the project. This right applies each time the drawings are submitted.

D. Erection Plan for Bridges: Submit an Erection Plan 10 days prior to beginning erection of structural steel members for documentation purposes only. The Engineer will not approve the Erection Plan. 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 primary members, secondary members, connections, etc. that must be installed and properly connected to provide structural integrity and stability.
5. Supporting calculations in accordance with the current edition of the AASHTO LRFD Bridge Design Specifications to demonstrate that factored resistances are not exceeded and that member capacities and final geometry will be correct.
6. Incorporate into the plan the requirements from this Section article 3.6.
7. Bolting procedure for field splices and diaphragms on that meets American Institute of Steel Construction (AISC) Manual of Steel Construction requirements.
8. A professional engineer, licensed in the State of Utah, will approve, sign, and seal the Erection Plan and supporting calculations. The professional engineer must approve any and all changes to the Erection Plan prior to implementation.
9. UDOT prefers an AISC Advanced Certified Steel Erector (ACSE)

PART 2 PRODUCTS

2.1 STRUCTURAL METALS

A. Follow AASHTO LRFD Bridge Construction Specifications, Section 11.3 as specified unless otherwise indicated.

2.2 HIGH TENSILE STRENGTH NUTS, BOLTS, AND WASHERS

A. Use bolts, nuts, and washers displaying the manufacturer's markings.

B. Bolts: As specified in AASHTO M 164 with the following modifications:

1. Maximum tensile strength:
   a. 150 ksi for bolts 1 inch or less in diameter
   b. 120 ksi for bolts larger than 1 inch in diameter

C. Nuts:
1. As specified in AASHTO M 291 or AASHTO M 293.
2. Use heat-treated Grades DH and 2H, except use Type DH3 nuts when Type 3 bolts are called for.

D. Washers: As specified in AASHTO M 293.

E. Load Indicator Washers: As specified in ASTM F 959.

F. Certification of Bolts and Nuts (Black and Galvanized): Subject to the Rotational Capacity Test, Section 6.3 AASHTO M 164 and the following requirements.

1. Go through twice the required number of turns (from snug tight condition) in a Skidmore-Wilhelm Calibrator or equivalent tension measuring device without stripping or failure as specified.
2. Maximum recorded tensile strength must be equal to or greater than 1.15 times the required fastener tension as specified.
3. Measured torque necessary to produce the required fastener tension must not exceed the value obtained by the following equation:

$$\text{Torque} \leq 0.25\ PD$$

Where:

Torque	=	Measured Torque (foot-lbs)
P	=	Measured Bolt Tension (lbs)
D	=	nominal diameter (feet)

4. Bolts and nuts require proof load tests as specified in ASTM F 606, Method 1 (Proof Load).
5. Bolts and nuts require wedge tests as specified in AASHTO M 164, Section 6.2.

G. Foreign Materials:

1. Use foreign manufacturers who have previously established the ability to furnish material uniformly and consistently within the specifications.

2.3 BEARINGS

A. Refer to Section 05822.

2.4 FABRICATION

A. Fabricate as specified in AASHTO LRFD Bridge Construction Specifications Section 18, UDOT Steel and Concrete Construction Manual, and Steel Quality Management Plan. AASHTO/AWS D 1.5.

B. The fabricator must have AISC, Major Steel Bridge (CBR) Certification if steel structure is to be part of a bridge structure.
   1. MSB (CBR) Certification not required for railings, grates, grate frames, and drain pipes. These items may be fabricated with Simple Steel Bridge Structures (SBR) Certification.

2.5 APPROACH SLAB DRAIN ANGLES AND GRATE

A. AASHTO M 270, Grade 36.

B. Hot-dip galvanize after fabrication. AASHTO M 111.

PART 3 EXECUTION

3.1 INSPECTION

A. Notify Engineer immediately upon placing the fabrication order to allow time for shop inspection.
   1. Do not begin fabrication until arrangements for shop inspection have been made.
   2. Facilitate inspection procedures on site and supply personnel as needed to properly inspect the work.

B. Allow authorized inspectors free and immediate access to all parts of the plant.

C. Furnish facilities for inspection of material and workmanship in the mill and shop.

D. The Inspector has the authority to reject any materials or work not meeting the specifications.
   1. Material accepted by the Inspector may be rejected if found defective at a later time.
   2. Replace or correct rejected material at no additional cost to the Department.
   3. Contractor may appeal disputes with the Inspector to the Engineer for a final decision.

3.2 INSTALL HIGH STRENGTH BOLTS

A. Testing:
   1. Provide a Skidmore-Wilhelm calibrator or other acceptable bolt tension- indicating device for bolt testing at the job site.

2. Use direct-tension indicators with solid plates when the fastener-grip length is too short to be tested in a Skidmore-Wilhelm calibrator.
3. Check the direct-tension indicators in a Skidmore-Wilhelm calibrator using bolts of sufficient length before using.

B. Test the installed bolt/nut/washer assembly periodically to verify compliance.

C. Use direct-tension indicator washers as specified to tighten high strength bolts.
   1. ASTM F 959.
   2. Tighten bolts according to the manufacturer's methods and procedures or as modified by Engineer.
   3. Tighten the fastener to reduce the gap to 0.005 inch or less regardless of which element is turned for tightening.

D. Install bolts as specified in AASHTO LRFD Bridge Construction Specifications, Section 11.5.6.4 and use the following procedure.
   1. Complete the *Bolted Field Splice Certification* form at the end of this section as bolt tightening progresses.
   2. Place direct-tension indicator washer where the washers will not be embedded in concrete.
   3. Use drift pins to align bolt holes and maintain dimensions and camber of the member.
   4. Insert bolts in open holes with washers as specified by the manufacturer, and hand tighten.
   5. Tighten at least 50 percent of the bolts or more as required to approximately ½ final tension to draw all plies of the connection into firm contact. Do not tighten any bolts to indicated full tension at this time.
   6. Remove drift pins and replace with bolts.
   7. Tighten bolts progressively from fixed or rigid points to the free edges.
   8. For field splices and diaphragms fully tighten 50 percent of bolts. Remaining bolts are to be snug tight before release of crane.
   9. Tighten all bolts to full tension.

E. 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, and 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. Use manufacturer recommended lubricant.

3.3 WELD

A. Weld as specified in AASHTO/AWS D1.5, except as modified by the contract.

B. Field welds must meet the same requirements as shop welds, including inspection by the Department.

C. When AISC CBR Certification is required for the fabrication of the element, do all field welding under the certification.

D. Comply with welding procedures and inspection requirements. Refer to UDOT Steel and Concrete Construction Manual.

E. Welding operators must be pre-qualified. Comply with UDOT Steel and Concrete Construction Manual.

3.4 BEARINGS AND ANCHORAGES

A. Do not place masonry bearing plates upon bridge seat bearing areas that are improperly finished, deformed, or irregular. Set bearing plates level in exact position with full even bearing.

B. Locate the anchor bolts in relation to the slotted holes in expansion shoes to correspond with the temperatures at the time of erection. Adjust nut-gap on anchor bolts as shown at the expansion ends to permit free movement of the span.

C. Form bridge seat bearing areas and place anchor bolts according to details shown.

D. Place so that identification mark is visible after completion of the bridge.

E. Do not weld exterior plates of bearings unless at least 1.5 inch of steel exists between the weld and the Elastomer.
   1. Do not subject the Elastomer or the bond to temperatures higher than 400 degrees F.

3.5 SURFACE PREPARATION STEEL

A. Refer to Section 09972 for surface preparation for painting of non weathering steel.

B. Weathering steel:
   1. Construct so that erection marks on the steel are not visible after the structure is completed.
   2. Commercially blast all surfaces according to the specification standards. Meet SSPC-SP 6.
   3. Commercially blast the following surfaces to meet SSPC-SP 10:
      a. Underside of the exterior portion of the top flange of fascia girders, and underside of bottom flange of all girders.
      b. The 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
   4. Develop even patinas at completion of welding repair and after surface has been accepted by engineer.
   5. Clean girders of any debris after deck concrete is placed
   6. Redevelop patina as needed.

3.6 ERECTION

A. Maintain responsibility for all aspects of girder erection during all stages of construction, including the protection of structural steel members, the workers, and the traveling public.

B. Erect structural steel members in compliance with the Erection Plan and in a manner that prevents damage to all elements of the structure.

C. Temporarily support, anchor, and brace primary members such as beams and girders in a manner during erection that will produce the proper alignment and camber in the completed structure.
   1. Install cross frames and diagonal bracing as necessary to provide stability and assure correct geometry.
   2. Provide temporary bracing or stiffening devices if necessary during any stage of erection.
   3. Support, anchor, and brace all erected superstructure members as detailed in the Erection Plan before allowing traffic under the bridge.

D. Design temporary supports and falsework in accordance with the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 3, Temporary Works.

E. Accurately assemble all parts as specified in the contract documents or erection drawings. Follow any match-marks.

F. Provide any additional materials that are required to keep both the temporary and final stresses within the allowable limits used in design.

G. Carefully handle materials so that no parts will be bent, broken, or otherwise damaged.
   1. Do not injure or distort the members when hammering.

H. Clean 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 Erection Plan or approved by the professional Engineer who approved, signed, and sealed the Erection Plan.

END OF SECTION

Bolted Field Splice Certification follows.

Bolted Field Splice Certification

Consecutively number splices looking stations ahead and increasing from left to right. Copy this page as required. Initial the appropriate box to certify that the bolt tightening has been done in accordance with 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 bolts are properly tightened.
Prior to the final inspection, send a completed copy of this form to the State Bridge Engineer, 4501 South 2700 West, Salt Lake City, UT 84119.

Project Number Structure Number

Splice No.	**Top Flange**		**Web**		**Bottom Flange**	
Plates were drawn into contact with each other before final tightening of any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts 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 any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts 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 any bolts.	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials	Contr. Initials	Inspect. Initials
Bolts 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

SECTION 05822

BEARINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install bearings and mating surface.

1.2 RELATED SECTIONS

A. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 270: Standard Specification for Structural Steel for Bridges

B. AASHTO LRFD Bridge Construction Specifications

C. ASTM A 240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

D. Federal Specifications

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Refer to Section 05120.

1.6 PAYMENT PROCEDURES

A. Bearings are included in the contract lump sum price for Structural Steel, Structural Concrete, or Pre-stressed Concrete.

PART 2 PRODUCTS

2.1 POLYTETRAFLUOROETHYLENE (PTFE)

A. Meet AASHTO LRFD Bridge Construction Specifications, Section 18.

B. Material composed of either filled or unfilled virgin PTFE sheets as specified.

C. Unfilled sheets must have minimum thickness of 0.03 inch, and filled sheets must be 0.10 inch ± 0.01 inch thick.

2.2 STAINLESS STEEL PLATE

A. Meet ASTM A 240, Type 304.

B. Minimum thickness of ¼ inch and minimum 20 micro inch (root mean square) mirror-like finish on the side that contacts the PTFE.

2.3 ADHESIVE MATERIAL

A. Meet Federal Specifications MMM-A-134.

B. Epoxy resin, FEP film or approved equal.

2.4 PREFORMED FABRIC PAD

A. Meet AASHTO LRFD Bridge Construction Specifications.

B. Comply with dimensions in plans.

2.5 ELASTOMERIC BEARING PAD

A. Meet AASHTO LRFD Bridge Construction Specifications, Section 18.

B. Place so markings are visible.

2.6 STRUCTURAL STEEL

A. Painted Structural Steel: As specified. Meet AASHTO M 270, Grade 36 Type steel.

2.7 MANUFACTURE – EXPANSION BEARINGS

A. Bond the preformed fabric pad to the PTFE at the bearing manufacturer's factory under controlled conditions and in strict conformance to the adhesive system manufacturer's written instructions.

B. Bond the filled or unfilled PTFE to a rigid, confining substrate that limits the flow (elongation) of the confined PTFE to not more than 0.009 inch under a load of 2,000 psi for 15 minutes at 78 degrees F for a 2 inch x 3 inch test sample. Do not bond the PTFE to the preformed fabric pad.
   1. Make the bonded PTFE surface smooth and free from bubbles.
   2. Polish the filled PTFE surfaces.

C. Weld the stainless steel with ⅛ inch continuous fillet welds to the sole plate.
   1. Do not allow the weld metal to project beyond the plane of the sliding surface.
   2. Use Type 309 electrodes or filler rods.
   3. Use welding procedures compatible with the stainless steel specified.

D. Prevent damage to the sliding surface.

E. Protect stainless steel and PTFE sliding surfaces during manufacture, shipment, and erection.
   1. Wipe the sliding surfaces clean immediately before setting the girder in place.
   2. Reject unit when the sliding surfaces are damaged by scratches, weld splatter, gouges, or overspray from painting, or other defects.
   3. Replace the damaged units with new units in good condition at no additional cost to the Department.

F. Coefficient of friction between the PTFE and the stainless steel not more than 0.10 at 2,000 psi bearing pressure.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 05831

EXPANSION JOINT MODIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove existing expansion joint system from bridge deck and install new 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

E. Section 05832: Expansion Joint

1.3 REFERENCES

A. AASHTO M 111: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 235: Standard Specification for Epoxy Resin Adhesives

C. AASHTO M 270: Standard Specification for Structural Steel for Bridges

D. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Shop drawing requirements: Comply with Section 05120.

1.6 FABRICATION

A. Certification: Comply with Section 05120, except that AISC, Simple Steel Bridge Structures (SBR) Certification is required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Structural Steel: Galvanize all structural steel as specified. Refer to AASHTO M 111.
   1. Steel Extrusions: AASHTO M 270, Grade 36.
   2. Plates: AASHTO M 270, Grade 36.
   3. Round Bars: AASHTO M 270, Grade 36.

D. Lubricating Material: Follow manufacturer recommendation.

E. Epoxy Resin Adhesive: Follow AASHTO M 235.
   1. Type II.
   2. Choose class rating consistent with the application temperature.

F. Reinforcing Steel (Coated): Refer to Section 03211.

G. Rigid Plastic Foam: Refer to Section 05832.

H. Neoprene Gland: Refer to Section 05832.

2.2 JOINT SYSTEMS

A. Refer to Section 05832.

2.3 TOLERANCES

A. Refer to Section 05832.

PART 3 EXECUTION

3.1 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. Place the saw cuts at the offset shown on the plans 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, and traffic areas and on railroad tracks.

3.2 CONCRETE REMOVAL

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal: Use 30-pound class hand operated jackhammers or smaller.
   2. Full Depth Removal: Use 90-pound class hand operated jackhammers or smaller.
   3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.

B. Parapet:
   1. Remove parapet concrete in the prescribed limits shown on the plans.
   2. Protect existing electrical conduit from damage.

3.3 REINFORCING STEEL

A. Existing Reinforcing Steel: Clean corrosion and adhering materials from remaining steel by sandblasting.

B. New Reinforcing Steel: Place coated reinforcing steel after sandblasting operations are complete.

3.4 SYSTEM INSTALLATION

A. Refer to Section 05832.

3.5 PLACE CONCRETE

A. Clean concrete and steel surfaces before coating with an epoxy adhesive. Follow adhesive manufacturer's application instructions.

B. Place concrete according to Section 03055 and Section 03310.

3.6 WATERTIGHT INTEGRITY TEST

A. Refer to Section 05832.

END OF SECTION

SECTION 05832

EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing expansion joint systems.

1.2 RELATED SECTIONS

A. Section 05120: Structural Steel

1.3 REFERENCES

A. AASHTO M 111: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 270: Standard Specification for Structural Steel for Bridges

C. ASTM C 578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

D. ASTM D 395: Standard Test Methods for Rubber Property-Compression Set

E. ASTM D 412: Standard Specification for Vulcanized Rubber and Thermoplastic Elastomer-Tension

F. ASTM D 471: Standard Test Method for Rubber Property – Effect of Liquids

G. ASTM D 573: Standard Test Method for Rubber – Deterioration in an air oven

H. ASTM D 1149: Standard Test Method for Rubber Deterioration-Surface Ozone Cracking in a Chamber

I. ASTM D 2240: Standard Test Method for Rubber Property – Durometer Hardness

J. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS

A. Expansion Joint System: Extruded neoprene seal element inserted into and bonded to a steel extrusion.

1.5 SUBMITTALS

A. Five copies of shop drawings for all fabricated structural steel materials. Refer to Section 05120.

PART 2 PRODUCTS

2.1 JOINT SYSTEMS LIST

A. The following systems are acceptable and are detailed in the plans.
   1. Wabo Strip Seal System
   2. D. S. Brown Strip Seal System

B. Use only one strip seal system on any single project.

2.2 STRUCTURAL STEEL

A. As specified.

B. Steel Extrusion: Meet AASHTO M 270, Grade 36.
   1. Galvanized according to AASHTO M 111.

C. Plates and Round Bars: Meet AASHTO M 270, Grade 36

D. Lubricating Material: Follow manufacturer's recommendation.

E. Neoprene Gland: Single convolution type with physical properties that comply with the requirements in Table 1.

Table 1

Properties for Neoprene Gland		
Property	**Requirements**	**ASTM**
Tensile Strength, min. psi	2,000	D 412
Elongation at Break, min. percent	250	D 412
Hardness, Type A Durometer (Modified)	(55 ± 5)	D 2240
Compression Set, 70 hours at 212 degrees F Method B (Modified)	40 percent	D 395
Oven Aging, 70 hours at 212 degrees F Tensile strength, loss, max. Elongation, loss, max.	20 percent 20 percent	D 573
Hardness, Type A Durometer (Points change)	0 to + 10	D 2240
Oil Swell, ASTM Oil 3, 70 hours at 212 degrees F Weight Change, max.	45 percent	D 471
Ozone Resistance 20% Strain, 300 pphm, in air at 104 degrees F (wiped with toluene to remove contamination)	No cracks	D 1149

2.3 RIGID PLASTIC FOAM

A. Any preformed, extruded, cellular polystyrene thermal insulation material that has a water absorption property of 0.3 or less.

B. Meet ASTM C 578.

2.4 FABRICATION – EXPANSION JOINT

A. Comply with Section 05120, except AISC, Simple Steel Bridge Structures (SBR) Certification is required.

2.5 SOURCE QUALITY CONTROL – EXPANSION JOINT

A. Examine the gland face and top of the extruded steel shape of each section for straightness after expansion joint and anchorage system fabrication. Use a string line stretched taut from curb point to curb angle point or necessary construction joint end.

B. Shop Tolerances: Steel surfaces must not deviate in straightness by more than ⅛ inch. The surface must not deviate more than $^{3}/_{32}$ inch when string line is stretched between ends and the point of maximum departure from true.

PART 3 EXECUTION

3.1 EXPANSION JOINT SYSTEM INSTALLATION

A. Install expansion joint system using manufacturer's recommendations. A factory-trained representative must be present during setting of the system, placement of concrete, and installation of the neoprene seal element.

B. Joint Width:
   1. Form the joint width using rigid plastic foam as shown on the plans. Anchor securely.
   2. Maintain separation of sections by placing rigid plastic foam between sections of the concrete parapet.

C. Joint Gland:
   1. install the gland so that the length of the joint has a continuous seal after the complete steel extrusion installation.
   2. Lubricate the steel extrusion cavity before installing the neoprene gland.
   3. Remove the foam used to form the joint opening and any other objects that may interfere with the installation and operation of the gland so the gland convolution hangs freely after installation.

3.2 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

A. Test expansion system in the presence of the Engineer to verify that joint areas can hold water for one hour without leakage.

B. Remove any leaking seals, clean steel extrusion grooves, and install new seals if leaking occurs during testing.

C. Field Tolerances for Expansion Joint: Re-examine steel surfaces again for straightness and shop tolerance requirements after installing joint system in its final position and before placing concrete.

D. Final In-place Tolerances for Expansion Joint:
   1. Re-examine the extrusion gland face again after concrete placement. Deviations from the string line of more than ¼ inch are not allowed. The parallel extrusion faces must not deviate from each other by more than ⅛ inch at any location.
   2. Finish the top of the extrusion to the grade requirements of the concrete or bituminous material being placed on the bridge deck.

END OF SECTION

SECTION 05835

MODULAR EXPANSION JOINT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Install new modular expansion joint system and recessed parapet cover plate.

B. Remove existing expansion joint system from bridge deck and install new modular expansion joint system and recessed parapet cover plate.

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 03392: Penetrating Concrete Sealer

E. Section 05120: Structural Steel

F. Section 05832: Expansion Joint

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 164: High-Strength Bolts for Structural Steel Joints

C. AASHTO M 232: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

D. AASHTO M 235: Epoxy Resin Adhesives

E. AASHTO M 270: Structural Steel for Bridges

F. AASHTO M 291: Carbon and Alloy Steel Nuts

G. AASHTO M 293: Hardened Steel Washers

H. AASHTO/AWS D 1.5

I. AASHTO LRFD Bridge Design Specifications

J. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

K. ASTM D 395: Rubber Property-Compression Set

L. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

M. ASTM D 471: Rubber Property-Effect of Liquids

N. ASTM D 573: Rubber-Deterioration in an Air Oven

O. ASTM D 1149: Rubber Deterioration-Surface Ozone Cracking in a Chamber

P. ASTM D 2240: Rubber Property-Durometer Hardness

Q. American Institute of Steel Construction (AISC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Shop drawing requirements: Comply with Section 05120. Have shop drawings and calculations signed and sealed by a professional engineer licensed in the State of Utah. Include calculations, fatigue design, and a load factor design for all structural elements, connections, and splices.

B. Certification: Comply with Section 05120, except that AISC, Simple Steel Bridge Structures (SBR) Certification is required.

C. Show complete details for the joint seal assembly, anchorage components, and method of installation to be followed. Include the concrete recess details and any required revisions or additions to concrete, reinforcement, structural steel or other components.

D. Temporary bridging plan for any Modular Expansion Joint for which construction traffic is anticipated following installation.

E. Mill Test Report (MTR) for all structural steel. Provide item number and name on all materials submittals. Refer to Section 05120.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete: Class AA(AE). Refer to Section 03055.

B. Cement: Refer to Section 03055.

C. Structural Steel: Galvanized all structural steel as per AASHTO M 111 except where stainless steel and those surfaces coated with PTFE.
   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. Weld: AASHTO/AWS D1.5.

D. Bolts, Nuts, and Washers: Galvanize as per AASHTO M 232.
   1. Bolts: AASHTO M 164.
   2. Nuts: AASHTO M 291.
   3. Washers: AASHTO M 293.

E. Lubricating Material: Follow manufacturer recommendation.

F. Epoxy Resin Adhesive: Follow AASHTO M 235.
   1. Type II.
   2. Choose class rating consistent with the application temperature.

G. Reinforcing Steel (Coated): Refer to Section 03211.

H. Rigid Plastic Foam: Type 9, density of 2 lb/ft^3. ASTM C 578.

I. Neoprene Gland: Single convolution type with the following physical properties:

Table 1

Neoprene Gland Physical Properties		
Property Method	**Requirements**	**ASTM**
Tensile Strength, min. psi	2,000	D 412
Elongation at break, min. percent	250	D 412
Hardness, Type A Durometer (modified)	55 ± 5	D 2240
Compression Set, 70 hr. at 212 degrees F. Method B (modified)	40 percent	D 395
Oven Aging, 70 hr. at 212 degrees F. Tensile Strength. Loss, max. Elongation, loss, max.	 20 percent 20 percent	D 573
Hardness, Type A Durometer (points change)	0 to + 10	D 2240
Oil Swell, ASTM Oil 3, 70 hr at 212 degrees F. Weight Change, max	45 percent	D 471
Ozone Resistance, 20 percent Strain, 300 pphm in air 70 hr. at 104 degrees F. (modified)	No cracks	D 1149

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.

C. Design and fatigue test the transverse separation beams, support bars, and other structural elements following the guidelines provided in the current edition of the AASHTO LRFD Bridge Design Specification.

PART 3 EXECUTION

3.1 FABRICATION

A. Modular Expansion Joint: Comply with Section 05120 except AISC, SBR 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. Use a string line stretched taut from curb angle point to curb angle point.

C. Shop Tolerances:
   1. Steel surfaces are not to deviate from the string line by more than ⅛ inch.
   2. No surface is to deviate more than $^{3}/_{32}$ inch when the string line is stretched between either end or crown point and the point of maximum departure from true.

3.2 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 such a manner that the concrete deck is not damaged.

B. Concrete Saw Cuts
   1. Place the saw cuts at the offset shown on the plans 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.

3.3 MODULAR EXPANSION JOINT MODIFICATION FOR CONCRETE REMOVAL

A. Use jackhammer method to remove existing concrete.
   1. Partial Depth Removal: Use 30-pound class hand operated jackhammers or smaller.
   2. Full Depth Removal: Use 90-pound class hand operated jackhammers or smaller.
   3. Operate jackhammers at an angle greater than 45 degrees as measured from the deck surface.

B. Parapet:
   1. Remove parapet concrete in the prescribed limits shown on the plans.
   2. Protect the conduit from damage where existing electrical conduit is encountered.

3.4 MODULAR EXPANSION JOINT MODIFICATION FOR REINFORCING STEEL

A. Existing Reinforcing Steel: Clean steel that remains in place thoroughly of all corrosion and adhering materials by sandblasting.

B. New Reinforcing Steel: Place coated reinforcing steel after sandblasting operations are complete.

3.5 REINFORCING STEEL

A. Form and place reinforcing steel as shown on plans.

3.6 SYSTEM INSTALLATION

A. Install expansion joint system according to the manufacturer's recommendations.

B. Have a factory-trained representative present during system setting, concrete placement, neoprene seal element installation, and during the watertight integrity test.

C. Verify the assembly provides a smooth riding joint without slapping of components or wheel tire rumble.

3.7 JOINT WIDTH

A. Form the joint width as shown on the plans using rigid plastic foam. Anchor securely.

B. Place rigid plastic foam between sections of concrete parapet to maintain separation of sections.

3.8 PLACE CONCRETE

A. Clean concrete and steel surfaces before coating with an epoxy adhesive. Follow adhesive manufacturer’s application instructions.

B. Place concrete and apply penetrating concrete sealer. Refer to Sections 03055, 03310, and 03392.

C. Keep traffic off the expansion joint system for 72 hours after placing concrete or until concrete has reached its design strength.

3.9 INSTALL JOINT GLAND

A. Install the gland after the complete steel extrusion installation to ensure that the length of the joint has a continuous seal.

B. Lubricate the steel extrusion cavity before installing the neoprene gland.

C. Remove the foam used to form the joint opening and any other objects prior to watertight integrity test. Gland convolution must hang freely after installation.

3.10 FIELD QUALITY CONTROL AND WATERTIGHT INTEGRITY TEST

A. Refer to Section 05832.

3.11 RECESSED PARAPET COVER PLATE

A. Place recessed parapet cover plate as shown on plans.

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. AASHTO Standard Specifications for Highways and Bridges

D. American Wood-Preservers' Association (AWPA) Book of Standards

E. Southern Pine Inspection Bureau (SPIB) Standard Grading Rules

F. Western Wood Products Association (WWPA) Standard Grading Rules

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 STRUCTURAL TIMBER AND LUMBER

A. Refer to AASHTO M 168.

B. Treat if required following AASHTO M 133.

2.2 POSTS

A. Wood posts that comply with the current WWPA Standard Grading Rules or SPIB Grading Rules.

B. Pressure treated:

C. 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, or Ponderosa Pine, Grade No. 1 or better.

D. 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.

E. Steel Post with Wood Block:
1. Routed wood offset block of Southern Yellow Pine.
2. Surfaced or rough sawn blocks.
3. Grade No. 1.

F. Mailbox Post: Provide new material for post, shelf, and brace.
1. Sound fir, hemlock, or pine.
2. Free from all decay, splits, or other defects that weaken the material.
3. Dimensions as shown on the plans.

2.3 TREATMENT

A. Meet AASHTO Standard Specifications for Highway Bridges and AASHTO M 133.

B. Meet AWPA standards for treatment type and quality.

C. Use rodent-repellent treatment for any timber in contact with the ground.

D. Apply salt treatment to mailbox post and lumber requiring painting.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 07105

WATERPROOFING MEMBRANE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare an entire concrete deck and the approach slabs or specified structure joint areas for waterproofing membrane.

B. Place waterproofing membrane.

1.2 RELATED SECTIONS

A. Section 03934: Structural Pothole Patching

1.3 REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

B. ASTM D 5: Penetration of Bituminous Materials

C. ASTM D 36: Softening Point of Bitumen (Ring-and-Ball Apparatus)

D. ASTM D 146: Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

E. ASTM D 882: Tensile Properties of Thin Plastic Sheeting

F. ASTM D 3236: Apparent Viscosity of Hot Melt Adhesives and Coating Materials

G. ASTM E 96: Water Vapor Transmission of Materials

H. 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, specifications, 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 unless the deck is surface dry.

1.7 SCHEDULE

A. Notify the Engineer at least one week before installing the membrane.

PART 2 PRODUCTS

2.1 HOT POURED POLYMER MEMBRANE

A. Characteristics:
   1. Single Component Elastomeric Material
   2. Applied hot
   3. Spreadable to uniform thickness after cooling
   4. ASTM C 578

B. Mechanical Properties:
   1. Penetration, Max: 100
   2. Pliability, at 10 degrees F: No cracks when bent 180 degrees over a 1-inch mandrel.

2.2 RUBBERIZED ASPHALT MEMBRANE

A. Characteristics:
   1. Laminate Form
   2. Heat Resistant
   3. Self-adhesive surface protected by special release paper

B. Mechanical Properties:

Table 1

Mechanical Properties		
Property	**Method**	**Value**
Thickness, inch min.		0.065
Permeance-Perms, grains/sq ft·hr·inhg	ASTM E 96, Method B	0.10
Tensile Strength, psi	ASTM D 882, modified for 1 inch opening	50
Elongation, percent	ASTM D 882, modified for 1 inch opening	75
Puncture Resistance (Mesh), lb	ASTM E 154	200
Pliability, at -15 degrees F	ASTM D 146	No cracks in mesh or rubberized asphalt when bent 180 degrees over a ¼ inch mandrel

2.3 PATCHING CONCRETE

A. Refer to Section 03934.

2.4 FIBERGLASS MATTING

A. Weight = 1.5 lb/yd^2

2.5 BINDER

A. Compatible with the matting material and conforming to the following requirements:

Table 2

Binder Requirements		
Property	**Method**	**Value**
Penetration, 0.1 mm	ASTM D 5	40-82
Softening point, min.	ASTM D 36	155 degrees F
380 degrees F. viscosity, cps	ASTM D 3236	1,000 - 1,800

PART 3 EXECUTION

3.1 PREPARATION

A. 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.

B. Asphalt Surface: Apply a ½ inch layer of Hot Mix Asphalt as shown on the plans to provide a flat deck surface when membrane will be placed on an asphalt surface.

C. Joints and Cracks: Bond a 12 inch wide strip of woven fiberglass reinforcing to the deck over cracks and joints greater than $^{3}/_{16}$ inch wide using a compatible binder.

3.2 APPLY MEMBRANE

A. Use either hot poured polymer membrane or rubberized asphalt membrane.

B. Hot pour polymer membrane: Follow manufacturer's recommendations for application temperatures, equipment, and procedures.
   1. Primer: Apply primer according to the instructions of the membrane manufacturer, if required.
   2. Application Rate: Apply at a uniform rate to yield a minimum membrane thickness of $^{3}/_{32}$ inch.
   3. Vertical Surfaces: Apply the membrane on existing vertical surfaces and curb faces to a height 1 inch above that required for the asphalt surfacing overlay without splattering.
   4. Defects: Repair membrane that exhibits pin holes surface blisters, crazing, or cracking after cooling.
   5. Protection: Protect the membrane from damage by using asphalt roofing felt (30 lb/200 ft^2) when asphalt surfacing is not placed within four hours of placing waterproofing membrane. Observe the following characteristics and procedures when using the asphalt roofing felt:
      a. Cover entire surface and lay dust side up.

b. Lay parallel to the centerline of the roadway with a minimum overlap of 4 inches between adjoining sections.
c. Bond overlap with suitable mastic or cement.
d. Place free of wrinkles, bubbles or other defects. Repair any placement defects.

6. Traffic: Allow only necessary rubber tire vehicles on the membrane system.
   a. Do not allow public traffic.
   b. Maintain the roofing material in good condition until covered with pavement.
7. Preparation for overlaying: Do not use a tack or prime coat on the top surface of the asphalt rolled roofing.

C. Rubberized Asphalt Membrane: Follow membrane manufacturer's recommendations for application temperatures, equipment, and procedures.
1. Primer: Use primer furnished by the manufacturer of membrane material. Apply primer to all surfaces to be covered by the membrane according to the manufacturer's recommended procedure and application rate.
2. Placement: Overlap prefabricated membrane strips at least 4 inches. Place joints in a shingling effect so water will drain effectively.
3. Bonding: Use hand rollers or other satisfactory pressure apparatus on the membrane to assure firm and uniform contact with the primed surfaces. Use a wide tipped torch to cause tackiness if an adhesive is required to create a good seal at joints.
4. Placement: Place the membrane on the vertical face of the concrete curb to the height of the finished overlay surfacing.
5. Defects: Protect the entire membrane from developing wrinkles, air bubbles, or other placement defects. Patch any torn or cut areas and narrow overlaps using a satisfactory adhesive and a piece of membrane. Extend the patch at least 4 inches beyond any defect. Bond the patch firmly to the surface.
6. Traffic: Allow only necessary rubber tire vehicles on the membrane. Do not allow public traffic. Maintain the membrane in good condition until covered with pavement.
7. Preparation for Overlaying: 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. Place required surfacing after the membrane has cured according to manufacturer's recommendations. Deposit, spread, and roll asphalt material so the membrane will not be damaged.

END OF SECTION

SECTION 07111

DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Apply of primer and seal coat to dampproof concrete surfaces according to specifications and plan details.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM D 41: Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

B. ASTM D 449: Standard Specification for Asphalt Used in Dampproofing and Waterproofing

C. ASTM D 1227: Specification for Emulsified Asphalt Used as a Protective Coating for Roofing

D. ASTM D 4263: Standard test method for indication of moisture in concrete

E. ASTM D 4479: Specification for Asphalt Roof Coatings—Asbestos Free

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Product Data for each material proposed for use. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates for each product signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Source Limitations:
   1. Obtain primary dampproofing materials and primers through one source from a single manufacturer.
   2. Provide secondary materials recommended by manufacturer of primary materials.

1.7 PROJECT CONDITIONS

A. Weather Limitations:
   1. Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturer's written instructions.

PART 2 PRODUCTS

2.1 PRIMER

A. Use asphalt for primer that complies with ASTM D 41.

2.2 SEAL COAT

A. Use one of the following:
   1. Hot-Applied Asphalt Seal Coat: ASTM D 449, Type I.
   2. Cold-Applied Asphalt Seal Coat: ASTM D 4479, Type I (asbestos-free)
   3. Cold-Applied Emulsified Asphalt Seal Coat: ASTM D 1227, Type III or IV.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates with installer present for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
   2. Test for surface moisture according to ASTM D 4263.

3.2 PREPARATION

A. Comply with manufacturer's recommendations for surface preparation.

B. Clean substrates of projections and substances detrimental to work.
   1. Fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
   2. The Engineer may require the surface to be scrubbed with water and a stiff brush where necessary.

3. Allow the surface to dry before applying the primer.

C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.

D. Protection of Other Work:
1. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated by dampproofing.
2. Prevent dampproofing materials from entering and clogging weep holes and drains.

3.3 GENERAL APPLICATION

A. Apply dampproofing to concrete surfaces as shown on the plans or as specified.

B. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by project conditions to ensure satisfactory performance of dampproofing.
1. Apply additional coats if recommended by manufacturer or if required to achieve coverage indicated.
2. Allow each coat of dampproofing to cure as per prime material manufacturer’s recommendations before applying subsequent coats.
3. Allow drying time prior to backfilling as per prime material manufacturer’s recommendations.

C. Apply dampproofing to provide a continuous plane of protection on specified concrete surfaces.
1. Lap dampproofing at least 6 inches onto intersecting concrete members such as wingwalls and headwalls.
2. Extend dampproofing 6 inches below top of base slab on concrete box culverts and three-sided structures.

3.4 HOT-APPLIED ASPHALT SEAL COAT

A. Do not apply hot asphalt when substrate condition causes foaming.

B. Kettle Temperature:
1. Comply with dampproofing material manufacturer's written recommendations, and keep at least 25 degrees Fahrenheit below the flash point.

C. Prime masonry and other porous substrates.

D. Apply a uniform coat of hot asphalt by mopping or spraying at not less than 20 lb or 2.5 gal/100 sq ft.

E. Apply a second coat as specified above.
   1. Apply double thickness of second coat where first application has failed to produce a smooth, shiny, impervious coat.

3.5 COLD-APPLIED ASPHALT SEAL COAT

A. Apply two brush or spray coats at not less than 1.25 gal/100 sq ft for first coat and 1 gal/100 sq ft for second coat, or 1 trowel coat at not less than 4 gal/100 sq ft.

3.6 COLD-APPLIED EMULSIFIED ASPHALT SEAL COAT

A. Apply two brush or spray coats at not less than 1.5 gal/100 sq ft for first coat and 1 gal/100 sq ft for second coat, 1 fibered brush or spray coat at not less than 3 gal/100 sq ft, or 1 trowel coat at not less than 4 gal/100 sq ft.

3.7 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION

SECTION 07921

SEALING EXISTING CONCRETE SLOPE PROTECTION JOINTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seal existing concrete slope protection joints.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03152: Concrete Joint Control

1.3 REFERENCES

A. ASTM C 578: Rigid, Cellular Polystyrene Thermal Insulation

B. ASTM D 412: Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Furnish the certificates of compliance and sealant material test results for each lot of material supplied.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rigid Plastic Foam
   1. Type 9, density of 2 lb/ft^3
   2. ASTM C 578

B. Backer Rod: Refer to Section 03152.

C. Portland Cement Concrete
   1. Refer to Section 03055.
   2. Maximum aggregate size ¾ inch.

D. Cement: Refer to Section 03055.

E. Sealant Material with the following characteristics:
1. Applied cold and curable under field conditions.
2. Polyurethane based, gun grade.
3. Elastomer, non-sag seal.
4. Bonds tightly to concrete sides and joints.
5. Physical properties when cured 21 days at 75 degrees F as in Table 1.

Table 1

Physical Properties		
Property	**Value**	**Method**
Modulus of elasticity at 100 percent elongation	132 psi	ASTM D 412
Hardness	40 ± 5	Shore A
Elongation at break	450 percent	ASTM D 412
Recovery	Greater than 90 percent	
Tensile strength	190 psi	ASTM D 412
Adhesive in peel	20 lb/inch	
Adhesive Loss	0 percent	
Service Range	- 40 degrees F to 150 degrees F	
Initial Cure, Tack Free depending on temperature and humidity	6 to 8 hours	
Final Cure	5 to 8 days	
Staining Characteristics	Non-staining	

PART 3 EXECUTION

3.1 JOINT LOCATIONS

A. Mark the existing joints and the joint limits in the presence of the Engineer. This applies to all joints that require sealing according to the Typical Vertical Joint Sealing Detail, and Typical Contraction Joint Sealing Detail in the plans.

3.2 PREPARE JOINTS AND CRACKS

A. Remove the existing joint material and all other debris from the designated joints. Keep concrete surfaces in the joints clean and dry at the time the backing rod and sealant are placed.

B. Remove curing compounds, oil, grease, dirt, and any other foreign materials from the joint concrete surfaces by sandblasting.

3.3 SEAL HORIZONTAL JOINTS AND CRACKS

A. Seal the horizontal joints and cracks as field marked.

B. Use a backer rod when the joint or crack width is greater than ½ inch.

C. Start at one side and proceed to the other side on horizontal grooves (cracks or joints).

3.4 SEAL VERTICAL JOINTS AND CRACKS

A. Seal the vertical joints and cracks as field marked.

B. Start from top to bottom on vertical grooves (cracks or joints.)

3.5 SEAL WINGWALLS AND BACKWALL JOINTS

A. Place the rigid plastic foam material (styrofoam) 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 styrofoam ⅜ inch in the joints so a groove is formed above the styrofoam filler.

D. Fill the groove above the styrofoam with sealant so the joint is sealed over completely.

3.6 PLACE SEALANT

A. Place with a hand- or power-operated caulking gun.

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.

3.7 LARGE JOINT AND CRACK SEPARATION

A. Re-establish the original joint design by filling vertical or horizontal joints with concrete when joint widths are greater than 2 inches.

B. Fill vertical or horizontal cracks with concrete when crack widths are greater than 2 inches.

END OF SECTION

SECTION 07922

RELIEF JOINT CRACK SEALING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and seal designated relief joints.

1.2 RELATED SECTIONS

A. Section 03152: Concrete Joint Control

1.3 REFERENCES

A. ASTM D 3405: Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

B. ASTM D 3406: Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS **Not Used**

1.6 CERTIFICATION

A. Submit the manufacturer's certification of compliance for all shipments.

1.7 DELIVERY

A. Deliver packaged material in unopened packages with labels clearly indicating the following:
   1. Name of manufacturer
   2. Manufacturer’s product name or product number
   3. Manufacturer’s batch or lot number
   4. The application temperature range
   5. The recommended application temperature and the safe heating temperature range

PART 2 PRODUCTS

2.1 MATERIALS

A. Backer Rod: Refer to Section 03152.

B. Crack Sealing Compound: Sealant with the following characteristics:

Table 1

Crack Sealing Compound		
Property	**Test Method**	**Requirement**
Tensile Strength Adhesion, 4 h Cure	ASTM D 3406	Section 4.7
Ductility		min. 12 inches at 0 .4 inch/min. at 40 degrees F
Force-Ductility		4 lbs max.
Flow	ASTM D 3405	Section 4.3
Asphalt Compatibility		at 140 degrees F
Workability		¼ inch penetration
Curing		45 minutes
Flexibility, ⅛ inch x 1 inch x 6 inches		no cracks

2.2 EQUIPMENT

A. Sealant placement equipment:
1. Capable of circulating hot oil for heat transfer to heat the product (sealant machines).
2. Do not use direct heat transfer units (tar pots).
3. Do not exceed the 525 gallon maximum product tank capacity of the sealant placement equipment.

B. Temperature control
1. Sealant unit required to have an approved ASTM Thermometer Number 50 degrees F, or a temperature measurement device capable of reading within ± 4 degrees F from 194 degrees F to 700 degrees F.
2. Observe the sealant manufacturer's instruction on application temperature.

PART 3 EXECUTION

3.1 PREPARATION

A. Sampling:
   1. Stockpile all sealant to be used on the project at least 20 working days prior to use. Keep the stockpile dry.
   2. Notify the Engineer when stockpile is established and ready to be sampled.
   3. Take at least one random sample of each batch or lot number (minimum of 11 lb/sample).
   4. Do not place any material until the batch or lot material has been approved.
   5. No claim or extension of contract applies when the material fails to meet specification.

3.2 APPLICATION

A. Apply designated joints as shown on the plans.

B. Clean 6 inches on both sides of the joint of foreign matter and loosened particles with a hot compressed air (HCA) heat lance immediately before sealing the joints. Adequate cleaning is determined by surface darkening at least 6 inches wide, centered on the joint.

C. Fill the joints following the Relief Joint Crack Sealing detail on the plans.

D. Use an appropriate backer rod in the joint opening where the depth and width of the joint opening are greater than 2 inches and ½ inch respectively.

E. Replace the sealant material picked up or pulled out at the Contractor's expense. The Contractor will remain liable for any damage to the traveling public resulting from sealant application or sealant pull-out.

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

A. Section 05120: Structural Steel

1.3 REFERENCES

A. ASTM D 4285 Standard Test Method for Indicating Oil or Water in Compressed Air

B. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

C. ASTM E 11:Standard Specification for Wire Cloth and Sieves for Testing Purposes

D. Federal Standards

E. Mine Safety and Health Administration (MSHA) Standards

F. National Institute for Occupational Safety and Health Administration (OSHA) Standards

G. Northeast Protective Coatings Committee (NEPCOAT)

H. The Society for Protective Coatings (SSPC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Detailed plan for approval for protection methods that includes Environmental Protection.

B. Source and gradation of the blast abrasive.

C. Type and source of solvent if required.

D. Manufacturer's information regarding the specified coating materials, including:
   1. Required wet and dry film thickness
   2. Project safety data
   3. Thinning recommendations
   4. Temperature requirements
   5. Profile recommendations
   6. Mixing and application procedures
   7. Required equipment

E. Test samples

F. Provide Engineer with a copy of Quality Control Plan. At a minimum it must contain procedures and verification of the following:
   1. Compression air check. Refer to ASTM D 4285.
   2. Dry film thickness – SSPC-PA2.
   3. Air temperature
   4. Humidity and Dew point
   5. Surface temperature
   6. Abrasive cleanliness check – SSPC AB 2
   7. Degree of cleanliness achieved
   8. Surface profile. Refer to ASTM D 4417 method C
   9. Batch number and amount of thinner used
   10. Batch number of paint used
   11. Mixing procedures
   12. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags

G. Provide daily reports to Engineer upon request
   1. Submit no later than 24 hours following the completion of work.

H. Copy of SSPC Certifications.

1.6 TEST SAMPLES

A. Department tests paint samples from each batch or lot prior to use.
   1. Submit samples to the Engineer.
   2. Paints must match the spectrum samples on file in the UDOT Central Laboratory.

B. Reject paint that does not match the standard.

1.7 PAINTER AND SANDBLASTER QUALIFICATIONS

A. Responsible Parties:
   1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 1.
      b. Remain certified for the duration of the project.
   2. Contractors, subcontractors, and fabricators performing shop surface preparation or coatings applications:
      a. Certification required prior to contract award by The Society for Protective Coatings to the requirements of SSPC QP 3 enclosed shop.
      b. Remain certified for the duration of the project.
      c. Do not perform work if certification has expired.
      d. Requests for time extension for any delay to the project completion due to an inactive certification will not be considered and liquidated damages apply.
      e. Notify the Department of any change in certification status.

1.8 PAYMENT PROCEDURES

A. Surface preparation and painting are included in the contract lump sum price for structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

A. Select a complete 3-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.

C. 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.

D. Properly mix coating system. Meet the manufacturer's recommendations and project specifications. Check that the bottom of the container is free of any unmixed pigments prior to use.

E. Use necessary equipment for the proper application of the specified coating. Observing safety practices in SSPC Paint Application Guide No. 3, "A Guide to Safety in Paint Application."

F. Use wet and dry film thickness gauges for testing the coating thickness during and after application.

PART 3 EXECUTION

3.1 INSPECTION

A. Engineer examines surfaces prior to surface preparation and prior to 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.

3.2 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 top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc. 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 after shear studs have been attached.

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. (SSPC-SP 10)
4. Remove all concrete drippings, abrasive, and paint residue. Vacuum the top and bottom flanges, splice plates, longitudinal stiffeners, hangers, etc., 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.

C. Weathering Steel:
1. Refer to Section 05120.

3.3 PREPARE PAINT MATERIALS

A. Mix and thin paint materials per 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 per the material standard. Refer to ASTM E 11.

D. Strain and continuously agitate the mixed material up to and during the time of application.

3.4 APPLY PAINT

A. Apply each coat at proper consistency and thickness in accordance with the manufacturer's recommendations including field coating. Use pressures recommended by the manufacturer of the coating system when using spray nozzles.

B. Produce a uniform, even coating that bonds to the underlying surface. Follow SSPC-PA1.

C. Apply field coats at the construction site after steel erection work is completed.
   1. Do not apply field coats until Engineer approves 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.

D. 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 with 15 minutes.

E. 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.

F. Thoroughly clean areas having deficient primer thickness to remove all dirt.

G. Apply an intermediate and top coat to any surface at the fabrication site that will be inaccessible for painting after field erection.

H. Do not load material for shipment until shop paint is dry to the touch.

I. Protect all paint systems. Place softeners between plates of cross frames and diaphragms.

3.5 PROTECTION

A. Suspend work if protection is unsatisfactory.

B. Protect pedestrian and vehicular traffic.

C. Protect from splatter, splashes, and overspray all portions of the structures that are not to be painted including superstructure, substructure, slope, and highway appurtenances. Protect where other damage during painting and blast cleaning operations 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.

3.6 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 PA2.

3.7 SUSPENSION OF WORK

A. Engineer may suspend work for questionable performance of the painter, blasting operator, or the equipment.

B. Work suspension results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, nonuniform color, improper curing, or any other defect in the coating system.

END OF SECTION

SECTION 09981

CONCRETE COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prepare concrete surfaces and apply a tinted concrete coating system to the areas designated to be coated as shown on the plans and as specified.

B. Prepare concrete surfaces and re-apply concrete coating over graffiti for a period not to exceed final owner acceptance.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM D 4262: Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces

B. ASTM D 4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Product data for each material proposed for use.
   1. Include manufacturer's technical information, manufacturer's recommendations for surface preparation, and application for each material proposed for use.

B. Submit a one quart sample for testing, manufacturer's certificate of compliance, and laboratory test results using infrared techniques for the concrete coating system.

C. Submit for approval three 8½ inch by 11 inch samples of each concrete coating color required on the project before ordering concrete coating materials.

1.6 FIELD EVALUATION

A. Apply the full color palate to one area of the concrete to be coated for evaluation of the color scheme by the Engineer before the full application of the concrete coating system.

PART 2 PRODUCTS

2.1 CONCRETE COATING SYSTEM

A. Use a silicone acrylic concrete sealer that provides a durable, opaque, deep penetrating, water repellent, decorative finish to concrete and masonry surfaces.

B. Tint the sealer to provide the colors shown on the plans or as specified.

PART 3 EXECUTION

3.1 GENERAL

A. Use only one coating material on an individual structure.

B. Furnish, prepare, apply, cure, and store all materials according to the product manufacturer's directions and as specified herein.
   1. Give special attention to the recommended temperature range for application.
      a) Material subjected to freezing will be rejected.
   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 concrete coating system to the concrete surfaces shown on the plans or as specified.

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 being coated.
   1. Cure 14 days as an alternate to 28 days if the concrete has a pH level of 10 or lower per ASTM D 4262 and no surface moisture per ASTM D 4263.
   2. Cure concrete patches a minimum of seven days before being coated.
   3. Meet manufacturer's requirements.

C. Thoroughly clean the concrete surface to be coated by pressure washing.
   1. Use a minimum water pressure of 3000 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 thoroughly with potable water if detergents or de-greasers are used in the cleaning process.

D. Perform pH test per 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. Rinse acid-etched surfaces with potable water no sooner than one hour after acid etch application and prior to re-testing the pH level.
   2. Repeat process until the pH level does not exceed 9.

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. Use compressed air for final cleaning.
   1. Use an air compressor equipped with suitable separators, traps, or filters that remove water, oil, grease, and other substances from the air line.

G. Comply with the manufacturer's recommendations for surface preparation if they exceed the requirements specified herein.

3.3 COATING SYSTEM APPLICATION

A. Do not apply the coating if the surface is wet due to rain or other precipitation.
   1. Allow all wet surfaces a 24-hour period to dry before coating.

B. Coat only when the outside air temperature will remain between 45 and 90 degrees Fahrenheit for 24 hours.

C. Coat areas shown on the drawings.
   1. Apply a minimum of two coats of the concrete sealer.

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 concrete sealer thoroughly before and during application.

F. Apply the first coat of the concrete sealer evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in one direction.

G. Thoroughly cure the first coat of the concrete sealer a minimum of 12 hours before the second coat of the concrete sealer is applied.

H. Apply the second coat of the concrete sealer evenly at an application rate of 1 gal sealer/350 to 400 sq ft working in the opposite direction of the first coat.

I. Apply a coat of the tinted concrete sealer evenly over the affected area using an application rate of 1 gal sealer/350 to 400 sq ft for graffiti removal.
   1. Use the same color as the original application.

J. Reduce pressure to prevent atomizing of product, which causes dry spray when applying the coating by spray application.
   1. Use a sprayer tip size 704/FX or equivalent.
   2. Spray from multiple angles to ensure that all surface texture impressions are covered.
   3. Spray upper areas from raised platforms.

K. Dilute the concrete sealer with Xylene at a rate of 8 gal/drum or approximately 15 percent when applying the first coat of sealer over smooth dense (steel formed) vertical surfaces.
   1. Do not dilute on more porous concrete or when applying the second coat.

L. Comply with the manufacturer's recommendations for application if they exceed the requirements specified herein.

M. Protect coated surfaces from damage or detrimental elements during drying and curing.

3.4 FIELD INSPECTION

A. Inspect surfaces to be coated after the surface is cleaned and after each coating for compliance with manufacturer's recommendations and this specification.

B. Use rubber rollers or other approved protective devices on scaffold fastenings.

3.5 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 coating and power washing 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 spreading or falling of abrasive materials and debris 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.

3.6 CLEAN UP

A. Follow the manufacturer's recommendations for cleaning spills and spatters.

3.7 SAFETY PRECAUTIONS

A. Follow safety precautions per manufacturer's product data sheets and Material Safety Data Sheet.

END OF SECTION

SECTION 09991

CLEANING AND REPAINTING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and repaint existing structural steel surfaces including all bearing units for existing paint systems that have red lead primer.

B. Remove existing paint from existing structural steel surfaces.

C. Prepare existing steel surface for repainting, and paint the cleaned structural steel surfaces.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM D 4285 Standard Test Method for Indicating Oil or Water in Compressed Air

B. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

C. ASTM E 11: Wire Cloth and Sieves For Testing Purposes

D. Federal Standards

E. Northeast Protective Coatings Committee (NEPCOAT)

F. Technology Guide Number 6 –Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations

G. The Society for Protective Coatings (SSPC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Detailed plan for approval for protection methods that includes Environmental Protection.

B. Source and gradation of the blast abrasive.

C. Type and source of solvent if required.

D. Manufacturer's information regarding the specified coating materials, including:
   1. Required wet and dry film thickness
   2. Project safety data
   3. Thinning recommendations
   4. Temperature requirements
   5. Profile recommendations
   6. Mixing and application procedures
   7. Required equipment

E. Test samples

F. Provide Engineer with a copy of Quality Control Plan. At a minimum it must contain procedures and verification of the following:
   1. Compression air check. Refer to ASTM D 4285.
   2. Dry film thickness. Refer to SSPC-PA2.
   3. Air temperature
   4. Humidity and Dew point
   5. Surface temperature
   6. Abrasive cleanliness check. Refer to SSPC AB 2.
   7. Degree of cleanliness achieved
   8. Surface profile. Refer to ASTM D 4417 method C.
   9. Batch number and amount of thinner used
   10. Batch number of paint used

G. Provide daily reports to Engineer upon request.
   1. Submit no later than 24 hours following the completion of work.

H. Submit a 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.
   1. Worker Health and Safety Program
   2. Environmental Protection and Monitoring Program
   3. Hazardous Waste Handling and Reporting of Release Program
   4. Provide Engineer with Quality Control Plan and Procedures.

I. Copy of SSPC Certifications

1.6 TEST SAMPLES

A. Department tests paint samples from each batch or lot.
   1. Submit samples to the Engineer.

2. Paints must match the spectrum samples on file in the UDOT Central Laboratory.

B. Reject paint that does not match the standard.

1.7 PAINTER AND BLASTER QUALIFICATIONS

A. Responsible Parties:
1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
   a. Obtain SSPC QP 2 Category A Certification prior to contract award from The Society for Protective Coatings.
   b. Remain certified for the duration of the project.
   c. Do not perform work if certification has expired.
   d. Requests for time extension for any delay to the project completion due to an inactive certification will not be considered and liquidated damages apply.
   e. Notify the Engineer of any changes in certification status.

1.8 COATING APPLICATION REQUIREMENTS

A. Have the painter, the blasting operator, or both consult with the manufacturer's technical representative for answers to technical questions relating to the application of the specified coating materials.

B. Obtain surface preparation approval from the Engineer before applying paint.

C. Use equipment capable of taking dry film thickness readings on all portions including nuts and bolts.

1.9 PROJECT CONDITIONS/WEATHER LIMITATIONS

A. Follow the manufacturer's recommendations if weather conditions require paint thinning.

B. Apply paint only when the following weather conditions exist:
1. The temperature of the air and the steel: above 40 degrees F, but not so hot as to cause the paint to blister.
2. The relative humidity:
   a. Less than 85 percent or such that the combination of temperature and humidity conditions inhibits surface condensation.
   b. 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.

c. Steel temperature a minimum of 5 degrees F above Dew point.

PART 2 PRODUCTS

2.1 MATERIALS

A. Blasting abrasive: type and size as specified.

B. Solvent: type and source as required.

C. Coating materials:
1. Mix properly following manufacturer's recommendations and project specifications.
2. Use necessary equipment for the proper application of the specified coating, observing safety practices found in SSPC Paint Application Guide No. 3, "A Guide to Safety in Paint Application."

2.2 COATING SYSTEM

A. Select a complete 3-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. 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.

C. Use coating materials properly mixed meeting the manufacturer's recommendations and project specifications. Check that the bottom of the container is free of any unmixed pigments prior to use.

D. Paint Color: Federal Standard No. 595.
1. Field coat: Color No. 26293.
2. Top coat: Color No. 26306.

E. Use necessary equipment for the proper application of the specified coating.

2.3 MIX

A. Mix the paint to a lump-free consistency with a high shear mixer such as a Jiffy mixer, according to the producer'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 that may have settled to the bottom of the container are thoroughly dispersed.

B. Strain the paint through a screen having 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 the time of application.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces including bearing units of all oil, grease, and dirt with clean petroleum solvents or steam cleaning prior to blasting operation. Refer to SSPC-SP10.

B. Blast surfaces clean to near white with 0.5 to 2 mil profile.

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, corners, etc., that cannot otherwise be cleaned.

F. Meet soluble salts requirements of SSPC and the coatings manufacturer.

G. Prime the surface within 8 hours from blasting.

H. Do not prime the surface if rust has started to form. Clean the surface again before applying the prime coat.

I. Protection:
   1. Fully contain all material resulting from paint overspray.
   2. Enclosure system must withstand extreme high winds.

3. Protect all portions of the structure that will not be painted.

J. Recover a minimum of 95 percent of debris from cleaning operation.
1. Sample debris from cleaning operation. Submit samples to UDOT Materials and an independent accredited Materials Testing Lab for composition and disposal evaluation.
2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.
3. Submit paint composition and disposal evaluation results from the independent materials testing lab. Disposition will be given to the contractor within 30 days. Dispose of waste paint as directed by the Engineer. Submit disposal certificates for all waste paint.

3.2 APPLICATION

A. Field Inspection:
1. Do not apply paint until the Engineer approves 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. Apply paint with spray nozzles at pressures recommended by the manufacturer of the coating system.

C. Prime Coat:
1. Maintain the dry film thickness of the prime coat between 2.5 and 6.0 mils. Refer to SSPC PA2.
2. Apply two or more coats without producing runs, bubbles, or sags if the required film thickness cannot be obtained by one coat.
3. Blast clean any coat that produces “mud-cracking” or adds more than 7.0 mils to a soundly bonded coating or bare steel. Refer to SSPC-SP 10. Re-coat the surface.
4. Thoroughly clean areas having deficient primer thickness with power washing equipment to remove all dirt. Wire-brush, vacuum, and re-coat the area.

D. Intermediate Coat: Apply paint to produce a uniform, even coating that bonds to the underlying surface. Refer to SSPC-PA 1.
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. Refer to SSPC PA2.

E. Finish coat: Keep the dry film thickness greater than 2 mils. Refer to SSPC-PA2.

F. Use wet and dry film thickness gauges for testing the coating thickness during and after application.

G. Painting safety: Follow SSPC Paint Application Guide No. 3, “A Guide to Safety in Paint Application.”

3.3 SUSPENSION OF WORK

A. Engineer may suspend work for questionable performance of the painter, blasting operator, or the equipment.

B. Suspension of work results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, non-uniform color, improper curing, or any other defect in the coating system.

END OF SECTION

SECTION 09992

CLEANING AND OVERCOATING STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean and overcoat existing structural steel surfaces including all bearing units for existing paint systems that have red lead primer.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. ASTM D 3359: Standard Test Methods for Measuring Adhesion by Tape Test

B. ASTM D 4285 Standard Test Method for Indicating Oil or Water in Compressed Air

C. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

D. ASTM D 4541: Standard Test Method for 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 prime an intermediate coat and a top coat of paint over the entire surface on each girder.

1.5 SUBMITTALS

A. Detailed plan for approval for protection methods that includes Environmental Protection.

B. Source and gradation of the blast abrasive.

C. Type and source of solvent if required.

D. Manufacturer's information regarding the specified coating materials, including:
   1. Required wet and dry film thickness
   2. Project safety data
   3. Thinning recommendations
   4. Temperature requirements
   5. Profile recommendations
   6. Mixing and application procedures
   7. Required equipment
   8. Method of application

E. Test samples

F. Provide Engineer with a copy of Quality Control Plan. At a minimum it must contain procedures and verification of the following:
   1. Compression air check. Refer to ASTM D 4285,
   2. Dry film thickness. Refer to SSPC-PA2.
   3. Air temperature
   4. Humidity and Dew point
   5. Surface temperature
   6. Abrasive cleanliness check. Refer to SSPC AB 2.
   7. Degree of cleanliness achieved
   8. Surface profile. Refer to ASTM D 4417 method C.
   9. Batch number and amount of thinner used
   10. Batch number of paint used
   11. Mixing procedures
   12. Paint repair procedures for scratches, gouges, holidays, mud cracking, runs, and sags

G. Provide daily reports to Engineer upon request.
   1. Submit no later than 24 hours following the completion of work.

H. Submit a site specific written 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.
   1. Worker Health and Safety Program
   2. Environmental Protection and Monitoring Program
   3. Hazardous Waste Handling and Reporting of Release Program
   4. Provide Engineer with Quality Control Plan and Procedures.

I. Copy of SSPC Certifications.

1.6 TEST SAMPLES

A. Department tests paint samples from each batch or lot prior to use.
   1. Submit samples to the Engineer.
   2. Paints must match the spectrum samples on file in the UDOT Central Laboratory.

B. Reject paint that does not match the standard.

1.7 PAINTER AND BLASTER QUALIFICATIONS

A. Responsible Parties:
   1. Contractors and subcontractors performing surface preparation or coatings applications in the field:
      a. Obtain SSPC QP 2 Category A Certification prior to contract award from The Society for Protective Coatings.
      b. Remain certified for the duration of the project.
      c. Do not perform work if certification has expired.
      d. Requests for time extension for any delay to the project completion due to an inactive certification will not be considered and liquidated damages apply.
      e. Notify the Engineer of any changes in certification status.

1.8 COATING APPLICATION REQUIREMENTS

A. Have the painter, the blasting operator, or both consult with the manufacturer's technical representative for answers to technical questions relating to the application of the specified coating materials.

B. Obtain surface preparation approval from the Engineer before applying paint.

C. Use equipment capable of taking dry film thickness readings on all portions including nuts and bolts.

1.9 PROJECT CONDITIONS/WEATHER LIMITATIONS

A. Follow the manufacturer's recommendations if weather conditions require paint thinning.

B. Apply paint only when the following weather conditions exist:
   1. The temperature of the air and the steel: above 40 degrees F, but not so hot as to cause the paint to blister.
   2. The relative humidity:
      a. Less than 85 percent, or such that the combination of temperature and humidity conditions inhibits surface condensation.
      b. 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.
      c. Steel temperature a minimum of 5 degrees F above the dew point.

PART 2 PRODUCTS

2.1 MATERIALS

A. Solvent: As recommended by the manufacturer.

2.2 COATING SYSTEM

A. Select a complete 3 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 No. 595
   1. Field Coat: Use color No. 26293
   2. Top Coat: Use color No. 26306

C. 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.

D. Properly mix coating system. Meet the manufacturer's recommendations and project specifications. Check that the bottom of the container is free of any unmixed pigments prior to use.

E. Use necessary equipment for the proper application of the specified coating, observing safety practices found in SSPC Paint Application Guide No. 3, “A Guide to Safety in Paint Application.”

F. Use wet and dry film thickness gauges for testing the coating thickness during and after application.

2.3 MIX

A. Mix the paint to a lump-free consistency according to the producer’s directions.
   1. Do not use paddle mixers or paint shakers.
   2. Keep paint in the original containers and mix until all the pigment is suspended.
   3. Continue mixing until all solids that may have settled to the bottom of the container are thoroughly dispersed.

B. Strain the paint through a screen having openings no larger than those specified for a No. 50 sieve. ASTM E 11.

C. Strain and continuously agitate the mixed material up to and during the time of application.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces of all oil, grease, debris, and dirt with clean petroleum solvents. Follow with high-pressure wash. (SSPC SP1)

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.
   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. In addition 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.
   4. Do not allow materials used or debris generated to fall onto surface below.

C. 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.

D. Recover a minimum of 95 percent of debris from cleaning operation.
   1. Sample debris from cleaning operation. Submit samples to UDOT Materials and an independent accredited Materials Testing Lab for composition and disposal evaluation.
   2. Place reclaimed waste paint in EPA-USDOT approved containment. Store at the project site.
   3. Submit paint composition and disposal evaluation results from the independent materials testing lab. Disposition will be given to the contractor within 30 days. Dispose of waste paint as directed by the Engineer. Submit disposal certificates for all waste paint.

E. Meet soluble salts requirements of SSPC and the coating manufacturer.

3.2 APPLICATION

A. Do not apply paint until the Engineer approves the prepared surface.
   1. Use rubber rollers or other approved protective devices on scaffold fastenings.
   2. Do not use metal rollers, clamps, and other types of fastenings that mar or damage freshly coated surfaces.

B. Apply paint with spray nozzles at pressures recommended by the producer of the coating system.

C. Apply a minimum dry film thickness of 2 mils spot prime, 2 mils intermediate coat, and a minimum of 1.5 mils for the top coat. Use a magnetic film thickness gauge for verification.

D. Apply two or more coats if the required film thickness could not be obtained by one coat without producing runs, bubbles, or sags.

E. Paint as described in the standard specifications to produce a uniform, even coating which bonds to the underlying surface. Refer to SSPC-PA 1.

3.3 SUSPENSION OF WORK

A. Engineer may suspend work for questionable performance of the painter, blasting operator, or the equipment.

B. Suspension of work results from inadequate surface preparation, improper profile, runs, sags, overspray, thin film thickness, excessive film build-up, uneven coating, non-uniform color, improper curing, or any other defect in the coating system.

END OF SECTION

SECTION 13551

GENERAL ATMS REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing all ATMS components as defined in the contract.

B. Provide all documentation required for the installation and testing of ATMS components.

1.2 RELATED SECTIONS

A. Section 00725: Scope of Work

B. Section 01554: Traffic Control

C. Section 01721: Survey

D. Section 13591: Traffic Monitoring Detector Loop

E. Section 13595: ATMS Integration

1.3 REFERENCES

A. AASHTO M 232: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

B. AASHTO Roadside Design Guide, current edition

C. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, current edition

D. ASTM F 1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

E. American Wire Gauge (AWG)

F. International Building Code (IBC)

G. International Municipal Signal Association (IMSA)

H. Manual on Uniform Traffic Control Devices (MUTCD; current edition)

I. National Electrical Code (NEC)

J. National Electrical Safety Code (NESC)

K. Underwriters Laboratory (UL)

1.4 DEFINITIONS

A. ATMS - Advanced Traffic Management System

B. CCTV - Closed Circuit Television

C. RMS - Ramp Meter System

D. RWIS - Roadway Weather Information System

E. TMS - Traffic Monitoring Station

F. VMS - Variable Message Sign

G. WIM - Weigh In Motion

1.5 SUBMITTALS

A. Provide two copies of all documentation to the Engineer. Install one additional copy in a weatherproof sealable sleeve and place in each field cabinet.

B. The general purpose and content of all required submittals is described in Table 1. Refer to the appropriate specifications for details of the submittal requirements and test procedures for each ATMS device. Obtain the newest version (at time of bid) of the UDOT test procedures for the local field operations test from the UDOT website. Refer to http://www.udot.utah.gov/go/standardsreferences

Table 1

Submittal Requirements		
Name	**Timeline**	**Description**
Contractor Furnished Material and Equipment Lists	Submit within 15 business days from Notice to Proceed.	Include the name of manufacturer, size, and identification number. Obtain approval from the Engineer before ordering any contractor furnished equipment.
Test Reports for Cable and Conductor Test, Local Field Operations Test, and Acceptance Tests.	Submit within five business days from the completion of a successful test.	Provide after the completion of a successful test. Test Reports are required for each appropriate ATMS device installation, including but not limited to CCTV, VMS, RWIS, WIM, Traffic Monitoring Detector Loops or other specified detection device, and Fiber Optic Communication Systems. Provide Test Reports in a 3-hole binder, printed format. Include the following in the Test Reports: 1) All test results including failed tests 2) Description of any observed discrepancies 3) Description of required corrective action 4) Estimated time to complete corrective action and re-test 5) Results of any corrective action
Completion Notice	Provide to the Engineer after all devices have successfully passed the Local Field Operations Tests, at least five business days before beginning acceptance tests.	Consists of the certification that all ATMS installations are compliant with all project requirements. Use the Local Field Operations Testing Completion Notification Form obtained from the UDOT website.
Compliance Certificate	Submit within five business days of receipt from the Manufacturer for each site.	Provide an installation compliance certification from the manufacturer on required equipment.
Manufacturer's Equipment Documentation	Must be received and accepted before Final Acceptance	Submit all factory issued manuals according to this Section, software, detailed shop drawings, wiring diagrams, certifications, warrantees, instruction sheets, and part lists for all contractor furnished items to the engineer.
As-Built Drawings	Hold Final Inspection after initial drawings are submitted. Notify and have Region Blue Stakes Coordinator present at Final Inspection. Final drawings must be received and accepted before Final Acceptance	Refer to Section 01721

C. As-Built Drawings
   1. Submit five hard copies and an electronic copy to the Engineer.

D. Factory Issued Manuals
   1. Acceptable factory manuals must contain technical, diagnostic, and preventative and troubleshooting maintenance information. Advertising brochures and catalog cuts are not acceptable.

1.6 WARRANTY

A. Provide warranties for all workmanship, furnished equipment, and components for one year following the date of acceptance.

B. Warranties are not required for State-Furnished equipment.

C. Take any corrective action necessary during the warranty period, within 72 hours of being notified by the Engineer, to restore any identified deficiency caused by defective workmanship or materials. Repair or replace defective items. Notify the Engineer when corrective action has been completed.

PART 2 PRODUCTS

2.1 WIRING

A. Copper, as specified. National Electrical Code (NEC).

B. Size as specified. American Wire Gauge (AWG).

C. Power Conductors:
   1. Power source conductors, copper, type RHH, USE, or RHW.

D. Signal Cable:
   1. Multi-colored cables, as specified.
   2. IMSA 20-1

E. Ground Wire:
   1. Solid, bare, soft-drawn, copper wire, as specified.
   2. NEC 250.1.

F. Detector Loop: Use Department certified detector loop splicer.

G. Detector Cables: Refer to Section 13591.

PART 3 EXECUTION

3.1 TESTING AND ACCEPTANCE

A. The following tests will be required for all appropriate ATMS devices:
   1. Cable and Conductor Test
   2. Local Field Operations Test
   3. Acceptance Tests
   4. Remote Operations Test where communication is established or available.

B. Notify the Engineer at least five working days before the proposed date and time of all tests.
   1. Obtain the newest version (at time of bid) of the ATMS Testing Prenotification Form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
   2. The Engineer or the Engineer's agent must witness the tests.

C. Perform the Cable and Conductor Test before any connections are made.
   1. Obtain the newest version at time of bid of the ATMS Cable and Conductor Test Form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
   2. Verify that all cables and conductors are installed according to the manufacturer's plans and recommendations before testing.
   3. Perform all resistance testing after final termination and cable installation but before any electronics or field device connections.
   4. Replace the cable. Retest new cable as specified above if any cable fail to meet these parameters or if any testing reveal defects in the cable.
   5. Furnish all equipment, appliances, and labor necessary to test the installed cable and conductors.

D. Refer to the contract specifications for device specific Field Operations Test procedures.

E. Refer to Section 13595 for acceptance testing procedures.

3.2 EXISTING FACILITIES

A. Repair any damage to traffic signal equipment, lighting equipment, utilities, and other ATMS items such as conduit, junction boxes, underground traffic signal circuits, cabinets, poles, power sources, or power conductors caused by contract activities, third party activities, or failure to maintain adequate traffic control or protection until final acceptance.
   1. Request a meeting with the Department and the party with current maintenance responsibility to verify that all existing equipment is in working order at the work site.
   2. Test all loops, cabling, connectors, cabinet operations, etc.
   3. Request, coordinate, and conduct the on-site meeting and provide all labor, materials, test equipment, and test documentation.
   4. Complete all testing as non-destructive.
   5. Replace or repair any equipment that is not functioning at the time the work is completed at no additional cost to the Department if no pre-testing is performed.

B. Locate and mark all utilities before beginning construction.
   1. Contact Blue Stakes and schedule locating underground utilities.
   2. Contact any utilities and local government agencies not participating in Blue Stakes locate services.
   3. Determine the exact location of all existing utilities by verifying markings with potholing before commencing work and be fully responsible for any damage that might result from failure to locate and preserve any underground, surface, and overhead utilities.

C. Contact the Engineer for inspection before restoring cover to any underground facilities repaired during contract execution.

D. Identify any conflicts with existing facilities and contact the Engineer to relocate any project foundations, trenches, or other items before further construction work.

E. Notify utilities for verification of working clearances and arrange to have a utility company inspector on site if necessary.

F. Place electrical service requests and orders. Coordinate with all other necessary utilities without delaying the project.

G. Identify and resolve any conflicts with existing utilities at locations pre-marked in the field by the designer.

H. Determine right-of-way boundaries before starting work. Do not proceed on work occurring outside Department right-of-way until the required permits, environmental clearances, and approvals are obtained from all entities.

I. Do not cut any limited access fences.

J. Perform all digging using hand tools or suction if any construction is to take place within two feet of existing facilities.

3.3 INSTALLED MATERIALS LOCATION

A. Notify the Region Permits Officer and Blue Stakes Coordinator when ATMS elements are installed and provide them information according to Section 01721.

B. Modify proposed equipment locations to avoid conflict with underground utilities or other obstructions as required. Obtain approval from the Engineer before modifying locations.

C. Coordinate with the Engineer to field locate all new facilities such as cabinet foundations, camera poles, detector poles, and junction boxes.

D. Field locate equipment with the Engineer.
   1. Avoid areas with poor drainage and place for minimum impact from thrown snow.
   2. Place for maximum accessibility and safety for maintenance personnel.
   3. Satisfy clear zone requirements as defined in the AASHTO Roadside Design Guide (current edition), Chapters 3 and 4.

E. Minimum distance behind concrete barrier or guardrail for all above ground equipment: 3 ft.

3.4 EXCAVATION

A. Do not damage streets, sidewalks, landscaping, or other surrounding features.

B. Do not excavate wider than necessary for the proper construction of the foundations and other equipment.

C. Place the material from the excavation in a position that will minimize obstructions to pedestrian or vehicular traffic and interference with surface drainage.

D. Remove all surplus excavated material and properly dispose of it within 48 hours as directed by the Engineer.

E. Do not cover any underground materials or equipment fill under any circumstances until inspected and approved by the Engineer.

F. Protect pedestrian and vehicular traffic from all excavations.

3.5 ANCHOR BOLTS

A. Place and hold anchor bolts in proper alignment, position, and height during concrete placing and vibrating.

B. Conform to minimum requirements of ASTM F 1554 Grade 55 for anchor bolts. Do not weld anchor bolts to reinforcing steel. Galvanize all nuts, washers, and anchor bolts according to AASHTO M 232.

C. Install anchor bolts according to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (current edition) Article 5.17. Retighten all nuts after the structure is fully loaded.

3.6 TRAFFIC CONTROL

A. Refer to Section 01554.

B. Contact each business manager 48 hours before construction impacts any business access. Place business access signs according to current MUTCD where access to the business is not readily apparent anytime an access is closed.

3.7 TEMPORARY TRAFFIC SIGNAL TIMING

A. Notify the Engineer and the Traffic Signal Coordination Engineer for approval before implementing temporary changes.

3.8 REUSE EXISTING CONDUIT AND JUNCTION BOXES

A. Reuse existing conduit (in-place) and junction boxes when NEC requirements and Department standards for conduit material and depth of cover can be met as specified by the Engineer.

3.9 ABANDON ATMS FACILITIES IN PLACE

A. Do not remove existing pull wire from conduit that is to be abandoned in place.

B. Obliterate all existing foundations left in place to a depth of at least 2 ft below the existing surface. Properly dispose of removed items.

C. Remove all conductors taken out of service except pull wires. Cut the ends even with the end of pipe if abandoning in place.

3.10 REMOVE AND SALVAGE ATMS EQUIPMENT

A. Remove existing equipment as specified.
   1. Maintain the integrity of the equipment during removal and transport.
      a. Contact the Engineer 48 hours before removal to arrange for Department inspection to verify Equipment condition or the equipment will be assumed functional and undamaged.
      b. Replace damaged equipment at no additional cost to the Department.
   2. Return equipment to the appropriate Department facility as indicated by the Engineer.

B. Salvageable poles and cabinets:
   1. Contact the Engineer at least 48 hours before removal.
   2. Return to appropriate Department facility.

C. Cable and wiring:
   1. Spool all cable to be salvaged neatly onto appropriately sized spools.
   2. Avoid cutting long cables whenever possible.
   3. Cut cables only at splice locations or as directed by the Engineer.
   4. Cap wires as described in this Section, article 3.12.
   5. Do not exceed the minimum bending radius and the maximum pulling tension recommended by the manufacturer's specifications at any time.

3.11 ELECTRICAL

A. Perform all work according to the National Electrical Code (NEC), National Electrical Safety Code (NESC), International Building Code (IBC), Manual on Uniform Traffic Control Devices (MUTCD), and Underwriters Laboratory (UL).

3.12 INSTALL WIRING

A. Conductors:
   1. Clean and dry the inside of the conduit before installing conductors.

2. Install grounding conductor in all power circuit conduits. Refer to NEC, Article 250.1.
3. Use NEC approved lubricants when pulling conductors in conduit.
4. Tape and seal the ends of unused conductors and label them as spares.
5. Use conductors that are color coded as specified in IMSA and comply with NEC, Article 310.

B. Ground wire:
1. Ground wire in non-metallic conduit must run continuously and be grounded at each junction box except in those conduits used solely for interconnect and detector circuits.
2. Bond the ground wire to the ground rod in each junction box.

C. Neatly arrange and support wiring within cabinets, junction boxes, and fixtures.

D. Wire splicing:
1. Splice wires only in detection circuits where the wire type changes in the junction boxes.
2. Mechanically secure, solder, individually insulate, and water seal all splices.

E. Do not exceed the minimum bending radius or the maximum pulling tension recommended by the manufacturer's specifications at any time.

F. Keep cable ends sealed at all times during installation using an approved cable end cap. Do not use tape to seal the cable end. Keep cable ends sealed until connectors are installed.

3.13 MAINTENANCE OR REPAIR

A. Repair, replace, maintain, and operate all installed ATMS devices until Final Acceptance. Includes but is not limited to:
1. Replacement of damaged cabling.
2. Repair or replacement of damaged conduit and junction boxes.
3. Repair or replacement of Department and Contractor furnished items.

B. Repair installation or replace equipment due to any damage as specified in Section 00725.

C. Emergency Maintenance: Until Final Acceptance of the ATMS device, provide emergency maintenance on a seven-day per week, twenty-four hour basis. Respond to the dispatcher within 15 minutes when called or paged by the dispatcher. Provide contacts and telephone numbers to the Engineer for the emergency service.

D. Limit emergency repair response (one hour maximum) to problems of a public safety nature such as exposed wires or knockdowns.

E. Non-emergency repairs: Initiate other non-emergency repairs within 24 hours of notice.

F. Failure to provide adequate routine or emergency repairs will result in the Department making the necessary repairs at the Contractor's expense.

END OF SECTION

SECTION 13552

RAMP METER SIGNALS AND SIGNING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing conduit, junction boxes, signal heads, signing, mounting brackets, wire, grounding, and foundations. Install all state furnished items. Includes all materials, labor, workmanship, equipment, testing, documentation, and incidental items required to install and test a complete and operational Ramp Meter system as shown in the contract.

1.2 RELATED SECTIONS

A. Section 02466: Drilled Shaft

B. Section 02891: Traffic Signs

C. Section 02892: Traffic Signal

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 13551: General ATMS Requirements

G. Section 13553: ATMS Conduit

H. Section 13554: Polymer Concrete Junction Box

I. Section 13555: ATMS Cabinet

J. Section 13591: Traffic Monitoring Detector Loop

K. Section 16525: Highway Lighting

1.3 REFERENCES

A. AASHTO LRFD Bridge Construction Specifications, current edition

B. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, current edition

C. American Iron and Steel Institute (AISI)

D. American National Standards Institute (ANSI)

E. Manual on Uniform Traffic Control Devices (MUTCD), current edition

F. National Electrical Code (NEC)

G. Underwriters Laboratories (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide samples of materials to the Engineer for approval when requested.

B. Provide all of the following submittals as described in Section 13551:
1. Contractor Furnished Material and Equipment Lists
2. Test Reports for the Cable and Conductor Test, the Local Field Operations Test, and the 30 Day ATMS Burn-In Test
3. Completion Notice
4. Compliance Certificate
5. Manufacturer's Equipment Documentation
6. As-Built Drawings with GPS locations

PART 2 PRODUCTS

2.1 FOUNDATION

A. Concrete: Class AA(AE) Concrete. Refer to Section 03055.

B. Reinforcing Steel: Coated steel. Refer to Section 03211.

2.2 RAMP METER POLE MOUNT SIGNAL ASSEMBLY

A. One 8-inch section signal head with red LED module for enforcement. No back plate required.

B. All signal heads: Refer to Section 02892. Louvered back plate required.

C. Regulatory Sign: MUTCD R10-6, 24 inch x 36 inch.

D. RS-22A"1 Vehicle Per Green" and RS-22B "2 Vehicles Per Green" Signs: 24 inch x 18 inch. Refer to AT Series Standard Drawings.

E. All signal head housings: Highway yellow with hoods.

F. Signal Pole: Refer to Section 02892 and SL Series Standard Drawings.

G. Two “Z” bars on the back of the sign to support against thrown snow. Refer to SN Series Standard Drawings.

2.3 RAMP METER MAST ARM SIGNAL ASSEMBLY

A. All 12-inch signal heads: Refer to Section 02892. Louvered back plate required.

B. RS-23A “1 Vehicle Per Green Each Lane” and RS-23B “2 Vehicles Per Green Each Lane” Signs: 60 inch x 36 inch. Refer to AT Series Standard Drawings.

C. All signal head housings: Highway yellow with hoods.

D. Signal Pole: Refer to SL Series Standard Drawings.

2.4 RAMP METER ADVANCED WARNING

A. Warning Sign: W3-3, 36 inch x 36 inch. Refer to AT Series Standard Drawings.

B. WS16-20p “Meter On” Blankout Sign: 30 inch x 24 inch. Refer to AT Series Standard Drawings.

C. WS16-21p “N-Bnd Ramp”, WS16-22p “E-Bnd Ramp”, WS16-23p “S-Bnd Ramp”, or WS16-24p “W-Bnd Ramp” Auxiliary Sign if applicable: 30 inch x 24 inch. Refer to AT Series Standard Drawings.

D. Signal Pole: Refer to Section 02892 and SL Series Standard Drawings.

E. Two “Z” bars on the back of the sign to support against thrown snow. Refer to SN Series Standard Drawings.

2.5 BOLTS AND NUTS

A. Follow Section 02892.

B. Follow Section 13551 for Anchor Bolts.

2.6 WIRE

A. Follow Section 02892 for signal cable specifications.

2.7 DETECTOR CIRCUIT

A. Follow Section 02892.

2.8 LUMINAIRE

A. Follow Section 02892 for luminaires installed on ramp meter signal pole.

B. Refer to Section 16525 for luminaires not installed on ramp meter signal pole.

C. Use 240-volt 400 watt luminaires.

2.9 GROUND ROD

A. Copper-coated steel as specified.

B. ANSI/UL 467

2.10 CONDUIT

A. Refer to Section 13553.

2.11 JUNCTION BOX

A. Refer to Section 13554.

2.12 ATMS CABINET

A. Refer to Section 13555.

2.13 MOUNTING BANDS AND BUCKLES

A. As Specified.

B. American Iron and Steel Institute, (AISI) Type 201.

C. 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 foundation, junction boxes, ground rod, grounding lug, 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.
   1. Field locate all conduit and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing new conductors.

D. Connect the controller and all wires as specified in the contract.

E. Furnish and install all incidental items such as wire nuts, grommets, tape connectors, and electrical nuts 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 FOUNDATION

A. Provide all material and workmanship according to AASHTO LRFD Bridge Construction Specifications.

B. Verify that the installation locations of the signal heads, mast arm, pole, and foundation have no conflict with existing underground and overhead utilities before work. Comply with all utility and Blue Stakes requirements.

C. See AT Series Standard Drawings for ramp meter signal assembly and advance warning details and placement.

D. Excavate for foundations. Refer to Sections 02466 and 13551.

E. Drill shafts into either native soil or compacted fill and cast the top of the shaft against the formwork for appearance. The forms may be withdrawn during concrete placement if formwork is required during drilling.

F. Tie reinforcing steel and conduit securely in place. Do not weld reinforcing steel, conduit, or anchor bolts.

G. Install reinforcing steel. Refer to Section 03211.

H. Cap all conduits before placing concrete.

I. Install weep hole in foundation. Refer to SL Series Standard Drawings.

3.3 ANCHOR BOLTS

A. Refer to Section 13551.

3.4 SIGNAL POLES

A. 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).

D. All fasteners and attachment hardware for bands and other equipment: stainless steel.

E. Adjusting 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.

3.5 INSTALL WIRING

A. Refer to Section 13551.

B. Mark cabinet cables with vinyl electrical color-coding tape as specified in Table 1. Meet UL 510. Lanes numbered from left to right – include HOV bypass as left lane.

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

C. 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 Green- Green indicative Blue- Enforcement (if present) or spare

3.6 RAMP METER SIGNAL ASSEMBLY SIGN

A. Follow Section 02891.

3.7 INSTALL SIGNAL HEADS

A. Do not install signal heads at the intersection until it is ready for operation.

B. Install directed and veiled optically programmed signals following the manufacturer's instructions. Mask each section of the signal with manufacturer recommended materials.

C. Use louvered back plates on those signal heads indicated. Use a minimum of four 0.12 inch stainless steel screws per section to mount the back plates or according to manufacturer's instructions.

D. Install ramp meter signal head toward vehicles approaching the intersection stop-bar. Lower Signal Head: axis or indication parallel to roadway surface.

3.8 INSTALL DETECTOR LOOPS

A. Follow Section 02892.

B. Refer to AT Series Standard Drawings for location of Presence and Discharge Loop.

C. Consult the Engineer for saw cut loops.

3.9 INSTALL LUMINAIRE

A. Refer to Section 16525.

3.10 TESTING AND ACCEPTANCE

A. Perform a Detector Loop Inductance and Resistance Test as described in Section 02892. Submit Detector Loop Inductance and Resistance Test to the Engineer for acceptance.

B. Perform the Local Field Operations Test after all ramp meter elements, equipment and hardware, power supply, detection device, and connecting cabling have been installed. Refer to Section 13591.
   1. Complete the Local Field Operations Test for Ramp Meters using the required form. Obtain the newest version at time of bid of the form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
   2. Perform testing after all construction for the site has been completed and the final road surface has been constructed.
      a. It is not necessary for the communications installation to be completed at the time of testing.
      b. It is not necessary that all stations be tested concurrently.

END OF SECTION

SECTION 13553

ATMS CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing conduit as specified in the contract. Unless otherwise specified, install conduit by trenching, boring, or plowing.

B. Detectable pull tape and all materials, labor, workmanship, equipment, and incidental items required for a complete system of conduit.

1.2 RELATED SECTIONS

A. Section 00725: Scope of Work

B. Section 01721: Survey

C. Section 02056: Embankment, Borrow, and Backfill

D. Section 02705: Pavement Cutting

E. Section 02741: Hot Mix Asphalt (HMA)

F. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork

G. Section 02892: Traffic Signal

H. Section 03575: Flowable Fill

I. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

A. ASTM D 2241: Standard Specification for Poly-Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

B. American National Standards Institute (ANSI)

C. National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA)

E. Railroad Specifications

F. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit and Fittings:
   1. Schedule 40 PVC rated at 194 degrees F as specified in NEMA TC-2, NEMA TC-3, ASTM D 2241, UL Listed
   2. High Density Polyethylene (HDPE) SDR11 rated as specified in ASTM D 2241
   3. Rigid steel as specified in UL-6. Galvanized as specified in ANSI C80.1
   4. Flexible watertight conduit and fittings as specified

B. Non-Metallic Conduit
   1. New, prefabricated.
   2. ATMS Multi-duct Conduit Types
      a. 1D = four 2-inch conduits
      b. 2D = eight 2-inch conduits
      c. 4D = sixteen 2-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 stripe of contrasting color
         Bank 4: same as bank 2 with a stripe of contrasting color

C. Meet or exceed all of the conduit manufacturer's recommendations for all materials used in the installation of conduits, such as sweeps, adapters, couplings, glue, plugs, and fittings. 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 to provide for watertight integrity.

E. Sweeps: conduit manufactured sweeps (11¼, 22½, 45, and 90 degree angles) complete with bell and spigot.

F. Pull Tape: flat profile, low stretch polyester, detectable, sequential footage marked, 1,200 lb tensile strength pull tape in each empty conduit.

G. Fiber optic and electrical buried cable marker warning tape:
   1. Material: Composite reinforced thermoplastic.
   2. Tape Color: Orange (communication) or Red (electric).
   3. Text: Caution Buried Communication Cable or Caution Buried Electric (front and back).
   4. Maximum distance between text: 5 feet.
   5. Text Color: Black.
   6. Width: 3-inch minimum (face or diameter).

H. Backfill
   1. Flowable Fill: Refer to Section 03575.
   2. Free Draining Granular Backfill Borrow: Refer to Section 02056.
   3. Native material: Compact per Section 02056.

I. Submit all material certifications to the Engineer for approval.

PART 3 EXECUTION

3.1 GENERAL

A. Base final conduit routing on actual field conditions at the time of construction to prevent conflicts with existing utilities including Blue Stake markings.

B. Do not place conduit directly above parallel utilities.

C. Obtain appropriate permits before work commences.

D. Record conduit longitudinal and depth GPS coordinates (x,y,z). Refer to Section 01721 and as-built drawings.

E. Bore conduit when crossing all roadways.

F. Install conduit under park strip where curb and gutter is present.

G. Maximum spacing between junction boxes is as follows:
   1. 1,000 ft for tangent surface street installations
   2. 2,500 ft for tangent highway installations

3. Reduce maximum spacing if horizontal or vertical deflection prevents the installation of cable within maximum tensile rating of the cable.

H. Conduit under Railroad Right-of-Way: Refer to Section 00725 and appropriate railroad specifications, such as Union Pacific Railroad, Standard Specifications:
1. Coordinate all work with appropriate Railroad personnel.
2. Complete Railroad Safety Training.

I. Minimum Cover of Conduit:
1. Minimum cover in sidewalks or paved surfaces: 3 ft.
2. Minimum cover in highway right-of-way, greater than 20 ft from the edge of the pavement: 3 ft.
3. Minimum cover in highway right-of-way, within 20 ft of the edge of the pavement: 5 ft.

J. The Department will not grant additional time or money for installing conduit in difficult subsurface conditions.

K. Obtain approval from the Department on conduit splice connectors before use.

3.2 INSTALLATION

A. Do not allow conduit to deflect vertically or horizontally along its length by a ratio greater than 10:1, (e.g. no more than 4-inch deflection per 40 inch in length) when installing conduit that houses communication cable.

B. Do not allow the sum total of the vertical and horizontal deflection of conduit and bends between any two junction boxes to exceed 270 degrees when installing conduit.

C. Locate 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. Refer to Section 02892.

D. Do not field bend conduit. 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

E. Install conduits that cross finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by boring, jacking, or drilling. Replace entirely any damaged concrete sections, joint to joint, at no additional cost to the Department.

F. Conduit Stub:
   1. Install conduit in a junction box per Section 13554 to allow for the continuation of a conduit run. Type and number of conduits as specified in the contract.
   2. Extend conduit stub to 10 feet from the junction box in line with the conduit run as specified in the contract.

G. Proof all conduits with an approved mandrel before installation of cabling and detectable pull tape.

H. Provide detectable pull tape in all empty conduits.
   1. Install continuously between junction boxes.
   2. Fasten securely to plug and leave 3 ft of pull tape slack inside of the conduit.
   3. Do not splice detectable pull tape in conduit.

I. Place all conduit that is encased in a structural member per current International Building Code and as approved by the Engineer.

J. Secure conduit on concrete structures with standard galvanized steel conduit clamps using an approved anchoring system.
   1. Install per manufacturer's requirements.
   2. Use waterproof conduit expansion fittings at structure expansion joint crossings.

K. Fill all new and existing conduit to a maximum of 40 percent as per NEC.

L. Encase all open trench conduit in flowable fill. Encase plowed and bored conduit in flowable fill at exposed locations, conduit splice points, and junction box connections.

M. Use galvanized rigid steel or flexible watertight conduit for above ground application. Use PVC or HDPE conduit for underground application.

N. Apply corrosion protection per NEC Article 346 to any portion of galvanized rigid steel conduit buried in the ground or encased in concrete.

O. 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 conduit.

P. Install a bushing or adapter at ends of all nonmetallic conduit that contains a conductor per NEC Article 346. Install rounded bushings on the ends of metal conduit per NEC Article 347.

Q. Install manufactured sweeps (11¼, 22½, 45, and 90 degree angle) with conduit compatible bell and spigot ends.

3.3 TRENCH

A. Paved Surface (asphalt concrete):
   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 per Section 02705.
   3. Refer to AT Series Standard Drawings for depth of flowable fill under paved surfaces.
   4. Compact soil under pavement per Section 02056.
   5. Evenly apply tack coat on final backfill before installing T-patch.
   6. Restoration patch: match the composition, density, and elevation (±¼ inch), of the existing surface per Section 02741.
   7. 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.
   2. Match existing pavement thickness, but new pavement thickness must be 3½ inches minimum, 8 inches maximum.
   3. Compact soil under pavement. Refer to Section 02056.
   4. Restore sidewalk or decorative pavement to original condition or better after work is completed. Refer to Section 02776.

C. Unpaved Surface:
   1. Use backfill that matches the composition, density, and elevation (±0.2 inch), of the existing surface per Section 02776.
   2. Dispose of surplus material daily.
   3. Use flowable fill from bottom of trench to 3 inches above top conduit.

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:
   1. Encapsulate conduit at least 3 inches above the top conduit with flowable fill.
   2. Continue flowable fill to the wall of the junction box to seal conduit entry into the junction box.
   3. Clean excess flowable fill from the inside of the junction box.

G. Install all conduits so the flowable fill completely surrounds all exterior surfaces of the conduit. Separate multi-duct conduits using a commercially available conduit spacer or approved equivalent.

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.

J. Do not place flowable fill within 8 inches of the finished grade in native earth.

3.4 BORE OR PLOW

A. Install flowable fill per this Section, article 3.3, at all exposed conduit locations.

B. Immediately contain and remove all drilling fluid outside the bore. Contractor's payment request will not be processed until all drilling fluid outside the bore has been removed and properly disposed.

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. For installation of cable or wire 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.
   5. Perform all additional work necessary to restore existing cable and conduit systems to original or better condition.

C. Use existing conduit only in-situ and as approved by the Engineer or as specified in the contract.

D. Use new conduit on all new installations.

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, and 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.

END OF SECTION

SECTION 13554

POLYMER CONCRETE JUNCTION BOX

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing 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 01721: Survey

B. Section 02056: Embankment, Borrow, and Backfill

C. Section 02842: Delineators

D. Section 02892: Traffic Signal

E. Section 03055: Portland Cement Concrete

F. Section 03152: Concrete Joint Control

G. Section 03575: Flowable Fill

H. Section 13551: General ATMS Requirements

I. Section 13553: ATMS Conduit

1.3 REFERENCES

A. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cubes)

B. ASTM C 496: Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

C. ASTM C 579: Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

D. ASTM C 580: Standard Test Methods for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

E. ASTM C 857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

F. ASTM C 1028: Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method

G. ASTM D 543: Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

H. ASTM D 570: Standard Test Method for Water Absorption of Plastics

I. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastic in a Horizontal Position

J. ASTM G 154: Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

K. American National Standards Institute (ANSI)

L. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 FILL

A. Free draining granular backfill borrow per Section 02056.

B. Granular backfill borrow per Section 02056.

C. Flowable fill per Section 03575.

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 sustain a minimum vertical test load of 33,500 lb (AASHTO HS 20 loading) as a stand-alone unit, over a 10-inch x 20-inch square steel plate centered on the cover and body as per ASTM C 857-95 design load A-16.

C. Furnish boxes, rings, and lids that meet the physical and chemical requirements listed in Table 1:

Table 1

Physical and Chemical Properties of Junction Box Components		
Property	**ASTM Test**	**Value**
Compressive Strength	C 109	11,000 psi
Flexural Strength	C 580	1,800 psi
Tensile Strength	C 496	1,700 psi
Effects of Acids	D 543	Very Resistant
Effects of Alkalis	D 543	Very Resistant

D. Furnish junction boxes that are tested according to the following ASTM testing procedures. Provide results upon request.
1. Ultraviolet Inhibitors: ASTM G 154
2. Flame-Resistance: ASTM D 635
3. Water Absorption Resistance: ASTM D 570

E. Furnish lids that have a non-skid surface for pedestrian traffic with a minimum coefficient of friction of 0.50 per ASTM C 1028 without the use of coatings.

F. Use lids for all junction boxes specified by application. Manufacture lids with the following markings in the logo area, in 1-inch recessed letters:
1. “Traffic Signal” when the junction box contains cables or wires for a traffic signal. Refer to Sections 02892 and 13551, CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element.
2. “Electric” when the junction box contains power conductors used for a traffic signal, CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element.
3. “Street Lighting” when the junction box contains street lighting conductors only. Inscribe “High Voltage” below the words “Street Lighting” when the junction box contains voltage above 600 V.
4. “Communication” when the junction box contains fiber optic cable or future use multi-duct conduit.
5. “Sprinkler Control” when the junction box contains sprinkler control conduit.

G. Lid Access Points: recessed reinforced steel pull slots to allow removal of cover with a hook or lever. Replace lid if damage occurs to the pulling point.

H. Bolts: stainless steel recessed hex head bolts with washer. Refer to AT Series Standard Drawings.

2.3 MAINTENANCE MARKERS

A. Fiber Glass posts: Orange, 4 inch wide by 4 ft tall, labeled "UDOT Fiber Optics." Refer to Section 02842.

2.4 CONDUIT PLUGS

A. Refer to Section 13553.

2.5 GROUND ROD

A. Ground Rods: 8 ft x ⅝ inch copper-coated steel ground rod as specified by ANSI/UL 467.

2.6 WIRING

A. Ground Wire: Refer to Section 13551.

2.7 CONCRETE COLLAR

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

2.8 EXPANSION JOINT MATERIAL

A. Preformed expansion joint filler. Refer to AT Series Standard Drawings and Section 03152.

2.9 PULL TAPE

A. Pull Tape: Refer to Section 13553.

2.10 LOCATE BALL OR DISK

A. Greenlee Omni Marker or approved equal.

PART 3 EXECUTION

3.1 BACKFILL

A. Place 12 inches of free draining granular backfill borrow under junction boxes.

B. Hand tamp 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 per 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 structure wall. Finish grout smooth and flush with the interior wall.
   1. Make drilled holes in junction box not more than ¼ inch larger than conduit diameter.
   2. Seal conduit ends inside all junction boxes with at least 2-inch thick duct caulking after wires are installed.
   3. Seal vacant conduit with a manufactured conduit plug and attach detectable pull tape. Refer to Section 13553.

C. Level the top of junction box and grade accordingly.

D. Field-locate junction boxes to avoid steep slopes and low lying locations with poor drainage.

E. Do not install junction boxes within the traveled way or shoulders.

F. Install bushings on end of all metallic conduits before cable installation.

G. Conduit in junction box:
   1. Do not install conduit within 2 inches of corner of junction box.
   2. Extend PVC conduit 2 inches and HDPE conduit 6 inches 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. Refer to AT Series Standard Drawings.

H. Saw cut concrete or other surfaces that require removal in the sidewalk area.
   1. Remove entire section of sidewalk.
   2. Replace with in-kind materials to match the existing grade.

I. Install Engineer-approved ½ inch preformed expansion joint filler around entire periphery of ring for junction boxes installed in paved surface.

J. Record GPS coordinates for all junction boxes according to as-built drawings. Refer to Section 01721.

K. Encase all conduit in flowable fill where conduit enters the junction box.

L. Provide a poured-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. Grout in accordance with ASTM C 579 and ASTM C 580.

M. Do not stack boxes.

N. Provide maintenance markers for junction boxes on freeways and rural highways. Place maintenance markers:
   1. A minimum of 20 ft from edge of pavement if junction boxes are within 20 ft of edge of pavement.
   2. At right-of-way where junction box is within 20 ft of right-of-way.
   3. Within 2 ft of junction box at all other locations.

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.

D. Secure ½ inch expansion joint material around the junction box before placing concrete collar.

3.4 GROUND ROD

A. Install ground rod to extend maximum 2 inches above box floor.

B. Attach splice enclosure to the ground rod with a ground wire.

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. Materials and procedures for installing ATMS cabinets according to the contract. Includes installing or modifying concrete foundations. Includes pad-mounted and pole-mounted cabinets.

B. Includes all materials, labor, workmanship, equipment, documentation, and incidental items required to provide a complete and operational ATMS Cabinet as shown in the contract.

1.2 RELATED SECTIONS

A. Section 02892: Traffic Signal

B. Section 03055: Portland Cement Concrete

C. Section 03152: Concrete Joint Control

D. Section 03211: Reinforcing Steel and Welded Wire.

E. Section 13551: General ATMS Requirements

F. Section 13553: ATMS Conduit

G. Section 13554: Polymer Concrete Junction Box

H. Section 13561: ATMS Power Service

1.3 REFERENCES

A. AASHTO M 111: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

C. ASTM B 766: Standard Specification for Electro-deposited Coatings of Cadmium

D. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications

E. National Electrical Manufacturers Association (NEMA) Standards

F. National Electrical Code (NEC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Submit samples of materials for approval when requested.

B. Provide the following submittals as described in Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Manufacturer's Equipment Documentation

PART 2 PRODUCTS

2.1 ATMS CABINET

A. Pad-Mounted Cabinet: State-Furnished NEMA 3R

B. Pole-Mounted Cabinet: Provide aluminum control cabinet, 0.125 inch minimum thickness with the maximum dimensions of 36 inch H x 24 inch W x 22 inch D that has the following:
   1. Pole mounting hardware.
   2. Anodized, bare, painted or anti-graffiti.
   3. Air filter with thermostat operated fan.
   4. Removable self-standing rack assembly with 1-PDA #2 with 1-power supply assembly. 19 inch equipment rack. EIA/TIA compliant.
   5. Corrosion resistant handle with Corbin locks and padlock eye.
   6. Two full size doors; 1- front, 1-rear.
   7. Two position bar stops on bottom of each door.
   8. Solid bottom.
   9. One fluorescent light.
   10. NEMA 3R compliant enclosure.

C. Provide fittings, ground rods, ground wire, other materials, equipments, labor, and all incidental items necessary to construct a complete and operational pole-mounted ATMS cabinet.

2.2 CABINET FOUNDATION

A. Concrete: AA(AE) required. Refer to Section 03055.

2.3 BOLTS, NUTS, AND HARDWARE

A. Provide wedge expansion type or poured in place anchor bolts for cabinet mounts.
   1. ¾ inch x 8 inch expansion anchor bolts.
   2. 9,000 lbf pullout strength.

B. Provide 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 ⅝ inch diameter pre-drilled holes.
   2. Cross-section dimensions: 1⅝ inch x 1⅝ inch minimum.

C. Provide wedge expansion anchor bolts to secure framing strut to foundation for framing struts.
   1. ½ 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. Provide stainless steel, galvanized, or zinc plated bolts, nuts, washers, struts, and hardware as specified.
   1. Steel as specified. Refer to ASTM A 307.
   2. Galvanized as specified. Refer to AASHTO M 111.
   3. Zinc plated as specified. Refer to ASTM B 766.

E. Provide nuts that are free running by hand for total thread length.

F. Provide all bolted connections with lock washers, locking nuts, or other approved means to prevent the connection nuts from backing off.

G. Provide nipples, elbows, and grommets necessary for wiring.

2.4 CONDUIT

A. Refer to Section 13553.

B. Refer to Section 02892.

2.5 JUNCTION BOX AND GROUND ROD

A. Refer to Section 13554.

B. Minimum spacing from any edge of junction box to any edge of concrete collar must be 10 inches.

2.6 POWER SOURCE

A. Refer to Section 13561.

2.7 TRANSFORMER AND DISCONNECT

A. Submit specifications for approval.

2.8 EXPANSION JOINT MATERIAL

A. Preformed expansion joint filler. Refer to AT Series Standard Drawings and Section 03152.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify the ITS Project Manager a minimum of 14 calendar days before picking up the ATMS Cabinet and Pole-Mounted ATMS Cabinet to coordinate pickup location and time.

B. Use maintenance platforms when surrounding area is not paved. Platforms provide access to the cabinets for maintenance activities. Locate cabinet in an area where full access is allowed.

C. Repair any damage to existing utilities.

D. 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. Use minimum forming above ground.

F. Provide minimum setback between foundation and all walls, guardrails, poles, and other above ground features. Refer to Section 13551.

G. Extend conduit 2 inches above the floor of the cabinet foundation.

H. 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 the contract for the number, size, and orientation of all conduits entering the junction boxes.
   3. Refer to AT Series Standard Drawings for number and type of conduit used between the cabinet and adjacent junction boxes.
   4. Use galvanized rigid steel Above ground. Use PVC underground.
   5. Install bushings on the ends of all conduit before cable installation.
   6. Provide 1 inch minimum spacing between each conduit in cabinet base. Cap conduit at both ends until used.

I. Place the cabinet foundation parallel to the roadway.

J. Cabinet foundation surfaces:
   1. Ordinary Surface Finish. Refer to Section 03110.
   2. Chamfer around top surface perimeter.
   3. Level top surface before cabinet installation.

K. Place preformed expansion joint filler at concrete joints.

3.3 INSTALL PAD-MOUNTED ATMS CABINET

A. Install pad-mounted cabinets so the door that accesses the front face of the control equipment is adjacent to the Type II-PC junction box. Securely fasten the cabinet onto the concrete foundation. 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. Provide a rain-tight seal that does not degrade the NEMA 3R. Refer to NEMA Standards Publication 250-1997 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.

F. Caulk between base of cabinet and top of foundation to form a watertight seal.

3.4 INSTALL POLE-MOUNTED ATMS CABINET

A. Install pole-mounted cabinets so the door opens downstream of traffic. Use stainless steel bands.

B. Drill and nipple holes in pole at each site. Touch-up by hot stick method.

C. Arrange all equipment installed in the cabinet in a neat and orderly fashion on shelf.

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 as described on AT Series Standard Drawings or an approved underground service pedestal as described in the SL Series Standard Drawings and in Section 13561 unless otherwise specified.

B. Install disconnect or underground service pedestal between 10-15 ft from the cabinet, away from roadway. Field locate with the Engineer.

C. Ground disconnect on ground rod located in Type I junction box at the cabinet base.

D. Ground the transformer to the control cabinet ground terminal.

E. Install disconnect and transformer according to AT Series Standard Drawings, SL Series Standard Drawings, and the NEC.

3.6 INSTALL WIRING

A. Refer to Section 13551.

B. Clamp the ground wire from the cabinet ground 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 13561 for Power Service.

END OF SECTION

SECTION 13556

CLOSED CIRCUIT TELEVISION (CCTV) ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing and testing a complete and operational CCTV system as specified in the contract.

B. State-Furnished non-lowering and Camera Lowering CCTV poles, positioner, and dome CCTV assemblies.

1.2 RELATED SECTIONS

A. Section 01721: Survey

B. Section 02466: Drilled Shaft

C. Section 03055: Portland Cement Concrete

D. Section 03211: Reinforcing Steel and Welded Wire

E. Section 03310: Structural Concrete

F. Section 13551: General ATMS Requirements

G. Section 13553: ATMS Conduit

H. Section 13554: Polymer Concrete Junction Box

I. Section 13555: ATMS Cabinet

J. Section 13595: ATMS Integration

1.3 REFERENCES

A. AASHTO M 270: Standard Specification for Structural Steel for Bridges

B. ASTM C 1107: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

C. American Iron and Steel Institute (AISI)

D. American Wire Gauge (AWG)

E. National Electrical Code (NEC)

F. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide all of the following submittals as described in Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Test Reports for the Cable and Conductor Test, the Local Field Operations Test, and the 30 Day ATMS Burn-In Test
   3. Completion Notice
   4. Manufacturer's Equipment Documentation
   5. As-Built Drawings with GPS locations per Section 01721

PART 2 PRODUCTS

2.1 CCTV POLE OR LUMINAIRE

A. Non-lowering CCTV Pole: State-Furnished 45 ft steel pole with anchor bolts.

B. Camera Lowering Pole: State-Furnished 45 ft, 60 ft, or 80 ft steel pole with anchor bolts.

C. Luminaire Mounted CCTV: State-Furnished luminaire vertical extension on signal pole

2.2 CCTV STEEL POLE FOUNDATION

A. Class AA(AE) concrete. Refer to Section 03055 and Section 03310.

B. Reinforcing Steel: Coated. Refer to Section 03211.

C. Anchor Bolt Templates: AASHTO M 270 Grade 36.

D. Non-Shrink Grout in according to ASTM C 1107.

2.3 JUNCTION BOX

A. Refer to Section 13554.

2.4 CCTV ASSEMBLY

A. State-Furnished:
   1. Positioner Camera assembly: includes camera, pan/tilt unit, control receiver, environmental enclosure.
   2. Dome Camera assembly: includes camera with integrated pan/tilt unit, control receiver, environmental enclosure.
   3. IPS-RDPE-2: Remote Data Port Enclosure, 24 Volt Power Supply, IPS cable.

2.5 CAMERA LOWERING SYSTEM

A. State-Furnished: 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.

2.6 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 unless otherwise approved. Provide copper pole grounding lug.

C. All stainless steel fasteners and attachment hardware for bands and other equipment: AISI Type 316

2.7 DATA SURGE SUPPRESSOR

A. State-Furnished Data Surge Suppressor with the following general characteristics (typical) and as per communication details:
   1. Typical application: RS-422
   2. Surge: 36 KA
   3. Turn-on at 10 mA: +2.8/-0.6 VDC.
   4. Resistance: 1 Ohm
   5. Capacitance: 30 pF.
   6. Energy: 310 ft-lb.
   7. Let-through: less than +10/-Vp (peak open circuit voltage at max current).
   8. -3dB (600 Ohms) BW: 95 Mhz.

9. Temperature: -40 degrees F to 185 degrees F Storage/Operating

2.8 VIDEO SURGE SUPPRESSOR

A. State-Furnished Video Surge Suppressor with the following general characteristics (typical) and as per communication details:
   1. Typical application: LAN, closed circuit video.
   2. Surge: 3000 Amps
   3. Turn-on Time: 4 ns for 2 kV/ns.
   4. VSWR: 1.2 : 1
   5. Insertion Loss: ≤0.3 dB
   6. Impedance: 75 ohms
   7. Temperature: -50 degrees F to 185 degrees F Storage

2.9 CCTV COMPOSITE CABLE

A. State-Furnished composite CCTV cable with the following characteristics:
   1. Outer Jacket
      a. Type 4E
      b. Type CMG CMR C
      c. UL listed
      d. JKT Riser
   2. Data
      a. 2 stranded conductors
      b. 18 AWG
      c. 0.10 inch PVC jacket thickness
   3. Power
      a. 3 stranded conductors
      b. 12 AWG
      c. 0.12 inch PVC jacket thickness
   4. Video
      a. 1-RG59 coaxial cable
      b. 95 percent Braid Coverage
      c. O/A 0.03 inch PVC

2.10 CONDUIT

A. Refer to Section 13553

PART 3 EXECUTION

3.1 INSTALLATION

A. Notify the ITS Project Manager a minimum of 14 calendar days before picking up the State-Furnished equipment to coordinate pickup location and time.

B. Load, transport, and install all State-Furnished materials per the manufacturer's instructions.

C. Mount CCTVs at the locations specified in this Section, article 2.1.

D. Provide foundation, junction boxes, ground rod, grounding lug, conduit, stainless steel mounting bands, ground wire, wire nuts, grommets, tape connectors, and electrical nuts, and all additional equipment and incidental items required for a complete and operational CCTV system.

E. Install all wiring, conduit, and junction boxes as specified in the contract.
   1. Field-locate all conduits per Section 13553 and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing camera cables and conductors.

F. Connect the camera, controller, and all wires as specified by the manufacturer.

G. Connect camera lowering system and terminate wires as specified by the manufacturer.

H. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

3.2 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. Comply with all utility and blue stake requirements.

B. Excavate for foundations. Refer to Sections 02466 and 13551.

C. Drill shafts into either native soil or compacted fill and cast the top of the shaft against the formwork for appearance. The forms may be withdrawn during concrete placement if formwork is required during drilling.

D. Tie reinforcing steel and conduit securely in place. Do not weld reinforcing steel, conduit, or anchor bolts.

E. Install reinforcing steel per Section 03211.

F. Place concrete per Section 02466 and 03055. Provide ordinary surface finish per Section 03310. Cap all conduits before placing concrete.

G. Place non-shrink grout between base plate and foundation surface after pole is installed.

H. Install weep hole in foundation per SL Series Standard Drawings.

3.3 ANCHOR BOLTS

A. Refer to Section 13551.

3.4 CCTV POLE

A. Install non-lowering poles with the hand hole facing away from traffic. 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.

B. Install ground lug and connect ground wire from lug to ground rod in the junction box.

C. Plumb all steel poles to the vertical with all camera equipment installed when adjusting the anchor bolt nuts.

D. Install steel lowering cable in pole such that no contact with any other cable is made during the raising and lowering of the CCTV.

3.5 CCTV AND CAMERA LOWERING ASSEMBLY

A. Assemble the CCTV system including camera and camera housing and prepare for installation per the manufacturer's instructions before delivery to the job site.

B. Assemble the Camera Lowering system on CCTV pole and install per manufacturer's instructions at the job site.

C. Deliver the CCTV and Camera Lowering systems to the job site, terminate all cabling, and install as specified in the contract.

3.6 CCTV COMPOSITE CABLE

A. Install CCTV composite cables in conduit and poles. Run cables continuously and without splices between the camera and cabinet.

B. Keep cable ends sealed at all times during installation using an approved cable end cap. Keep cable end sealed until connectors are installed.

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 in all cabinets. Refer to Section 13555.

E. Make all camera cable connections between the CCTV camera, RDPE (Pelco Remote Data Port Enclosure), surge suppression device and communications equipment, as required to provide a fully operational CCTV system.

3.7 POLE-MOUNTED CABINET

A. Refer to Section 13555.

3.8 JUNCTION BOX

A. Install junction box near pole if control cabinet is more than 20 ft from pole.

B. Refer to Section 13554.

C. Install ground rod per NEC 250.1

3.9 TESTING AND ACCEPTANCE

A. Successfully complete the following tests:
   1. Cable and Conductor Test: Refer to Section 13551.
   2. Local Field Operations Test: Use the Closed Circuit Television (CCTV) Local Field Operations Test form Instruction. Obtain the current version at the time of bid of the form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
      a. Conduct the test after the Cable and Conductor Test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.

b. Furnish all equipment, material, and labor necessary for the test.

3. Acceptance Tests: Refer to Section 13595.

END OF SECTION

SECTION 13557

VARIABLE MESSAGE SIGN

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Install and test all State-Furnished items including VMS sign assembly, VMS access platform, ATMS cabinet, and VMS controller.

B. Furnish, install, and test VMS support structures, sign connection hardware, catwalk, cabinet foundation, communications cable and any additional equipment required. Furnish all incidental items required to provide a complete cable connection between VMS controllers. Test the installed VMS and adjust the viewing angle as required.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02893: Overhead Sign Structure

C. Section 05120: Structural Steel

D. Section 13551: General ATMS Requirements

E. Section 13553: ATMS Conduit

F. Section 13554: Polymer Concrete Junction Box

G. Section 13555: ATMS Cabinet

H. Section 13595: ATMS Integration

1.3 REFERENCES Not Used

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide all of the following submittals as described in Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Test Reports for the Cable and Conductor Test, the Local Field Operations Test, and the 30 Day ATMS Burn-In Test

3. Completion Notice
4. Compliance Certificate
5. Manufacturer's Equipment Documentation
6. As-Built drawings with GPS locations

PART 2 PRODUCTS

2.1 VMS FOUNDATIONS

A. Refer to Section 02893.

2.2 JUNCTION BOX

A. Refer to Section 13554.

2.3 VMS SUPPORTS

A. Refer to Section 02893.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify the ITS Project Manager at least 14 calendar days before picking up the Overhead VMS display, VMS controller, and VMS cable (fiber optic).

B. Load, transport, and install all State-Furnished materials per the manufacturer's instructions and as shown in the contract.

C. Provide foundations, VMS supports, junction boxes, ground rod, grounding lug, conduit, and all additional miscellaneous items required for a complete and operational VMS.

D. Deploy traffic control devices, personnel, or both. Refer to Section 01554.

3.2 INSTALLATION

A. Install all wiring, conduit, and junction boxes as shown in the contract.
   1. Field locate all conduit and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing cables and conductors.

3. Install surge suppressors at the VMS Sign Controller and ATMS Cabinet when connected by conductive communications cable. Minimum specifications for surge suppressors are as follows:
   a. Protects Pairs 1-8
   b. Protects all Pins (8)
   c. Maximum Surge of 100 mA
   d. Turn on at 10 mA
   e. Typical Capacitance of 55 pF
   f. Series Resistance less than 0.02 Ω
   g. 0 to 100 percent Humidity
   h. Operates in -40 degrees F (-40 degrees C) to 185 degrees F (85 degrees C) Temperatures

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 watertight flexible conduit and fittings between the sign and sign support inserts. Use high-grade silicon seal to ensure a watertight seal around all fittings. Refer to Section 13553.

E. Make final adjustments to sign horizontal and vertical angles. Orient the VMS perpendicular to the viewing angle of motorists 800 ft before the sign. The Engineer may order adjustments to the sign angle during the initial installation.

F. Install power cabling and terminate in VMS cabinet as per plans, details, and VMS manufacturer instructions.

G. Furnish and install all incidental items such as wire nuts, grommets, tape connectors, and electrical nuts necessary to make the VMS system complete.

H. Install state-furnished VMS fiber-optic controller cable between VMS and VMS controller in ATMS cabinet.

I. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

J. Restore work area to the original condition or better after work is completed.

3.3 VMS FOUNDATIONS

A. Refer to Section 02893.

3.4 VMS SUPPORTS

A. Refer to Section 02893.

3.5 ATMS CABINET

A. Refer to Section 13555.

3.6 TESTING AND ACCEPTANCE

A. Successfully complete the following tests:
   1. Cable and Conductor Test: Obtain the current version at the time of bid of the ATMS Cable and Conductor Test from the UDOT web site. Refer to http://www.udot.utah.gov/go/standardsreferences
   2. Local Field Operations Test: Obtain the current version at the time of bid of the Variable Message Sign Local Field Operations Test form from the UDOT web site. Refer to http://www.udot.utah.gov/go/standardsreferences
      a. Conduct the Local Field Operations test after the Cable and Conductor test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.
      b. Verify physical construction has been completed according with the contract and that the connecting cabling has been properly installed.
      c. Furnish all equipment, appliances, and labor necessary for the test.
   3. Acceptance Tests: Refer to Section 13595.

END OF SECTION

SECTION 13558

HIGHWAY ADVISORY RADIO (HAR) PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. All materials, labor, workmanship, equipment, testing, documentation, and incidental items required to install a Highway Advisory Radio system as shown in the contract.

B. Furnish and install HAR wood pole.

C. Furnish and install junction box at the base of the pole with ground rods, ground wire, and all other incidental hardware. Furnish and install conduit and junction boxes required to provide a path from the HAR pole to the control cabinet junction box.

D. State-Furnished operational HAR system with power supply, transmitter, recorder, communication controller, pole-mount antenna, testing, and documentation.

1.2 RELATED SECTIONS

A. Section 13551: General ATMS Requirements

B. Section 13553: ATMS Conduit

C. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

A. National Electrical Code (NEC)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. Provide all of the following submittals as described in Section 13551:
1. Contractor Furnished Material and Equipment Lists
2. Test Reports for the Cable & Conductor Test
3. Completion Notice
4. Manufacturer's Equipment Documentation
5. As-Built Drawings with GPS locations

PART 2 PRODUCTS

2.1 HAR POLE

A. Wood Pole Mounted HAR: Class 5 or 6 Douglas Fir wood pole, treated with Chromated Copper Arsenate CCA Type C, 36 ft standard length and not less than 5½ inches diameter at top. Pole length may differ where approved.

2.2 JUNCTION BOX

A. Refer to Section 13554.

2.3 CONDUIT AND CLAMPS

A. Refer to Section 13553.

2.4 HAR ASSEMBLY

A. State-Furnished:
   1. HAR assembly, including transmitter, recorder, power supply, communication controller, antenna, and antenna cable.
   2. HAR cabinet

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all wiring, conduit, and junction boxes as specified in the contact.
   1. Field locate all conduits per Section 13553 and junction boxes to avoid drainage areas and steep slopes whenever possible.
   2. Protect existing conductors while installing HAR cables and conductors.

B. Furnish and install all incidental items such as bushings, conduit clamps, and conduit transition elements per the NEC.

C. Clear the equipment exterior of all loose rust and mill scale, dirt, oil, grease, and other foreign substances after installation.

3.2 WOOD HAR POLE

A. Install wood pole below grade to a minimum depth equal to one-sixth the total pole height.

B. Increase the installation depth by one times the diameter of the pole when wood pole is installed on a slope of 2:1 or greater. Measure depth from the down-slope side of the pole.

C. Backfill with native material in 1 ft lifts to match surrounding grade. Tamp each lift to 90 percent compaction.

3.3 HAR ASSEMBLY

A. Final HAR assembly and connection performed by others.

3.4 POWER AND COMMUNICATION CABLES

A. Install power and communication cables in conduit to local junction boxes. Leave sufficient slack for final installation. Include pull tape from the local junction boxes to the stubbed out conduit end for future cable installation.

B. Keep cable ends sealed at all times during installation using an approved cable end cap.

C. Do not violate the minimum bending radius and the maximum pulling tension recommended by the manufacturer's specifications at any time.

3.5 JUNCTION BOX

A. Refer to Section 13554. Install ground rod per NEC 250.1.

3.6 TESTING AND ACCEPTANCE

A. Successfully complete the following tests:
   1. Cable and Conductor Test: Refer to Section 13551.

END OF SECTION

SECTION 13559

NON-INTRUSIVE DETECTOR (NID) SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing Non-Intrusive Detector (NID) System.

1.2 RELATED SECTIONS

A. Section 01554: Traffic Control

B. Section 02892: Traffic Signal

C. Section 13551: General ATMS Requirements

D. Section 13555: ATMS Cabinet

E. Section 13556: Closed Circuit Television (CCTV) Assembly

F. Section 13595: ATMS Integration

G. Section 16525: Highway Lighting

1.3 REFERENCES

A. American Iron and Steel Institute (AISI)

B. National Electrical Manufacturers Association (NEMA) Standards

C. SSIG: SmartSensor™ Installation Guides

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide the following submittals as described in Section 13551:
1. Contractor Furnished Material and Equipment Lists
2. Test Reports for the Cable and Conductor Test, the Local Field Operations Test, and the 30 Day ATMS Burn-In Test
3. Completion Notice
4. Compliance Certificate

5. Manufacturer's Equipment Documentation
6. As-Built Drawings with GPS locations

PART 2 PRODUCTS

2.1 NON-INTRUSIVE DETECTOR

A. State-Furnished: Contact the Engineer for approved manufacturers and alternatives.
   1. Radar: Wavetronix Smart-Sensor, Model SS125 (standard) or Model SS105 (in special conditions), approved equal, or as specified for vehicle counting. Wavetronix Smart-Sensor Advance, Model SS200, approved equal, or as specified for dilemma zone detection. Refer to Section 02892.
      a. Surge Protector: Wavetronix Click! 200 or approved equal
      b. 24 VDC NID Power Supply: Wavetronix Click 201!, Click 202!, Click 205! or approved equal
      c. Contact Closure Cards: Wavetronix Click! 100, 172 or 174, or approved equal
   2. Video: Refer to Section 02892.
   3. Acoustic: Use only where approved.

2.2 POLE

A. State-Furnished:
   1. Luminaire Pole. Refer to Section 16525 and SL Series Standard Drawings.
   2. CCTV Pole. Refer to Section 13556 and AT Series Standard Drawings.
   3. Signal luminaire extension, vertical attachment, or arm. Refer to SL Series Standard Drawings.

2.3 MOUNTING EQUIPMENT

A. State-Furnished: NID Sensor Mount

B. All other mounting hardware necessary: AISI Type 316 Stainless Steel

2.4 CABLES AND CONDUCTOR

A. State-Furnished: NID Sensor Cable as required by manufacturer.

2.5 SURGE PROTECTOR ENCLOSURE ON POLE

A. State-Furnished Enclosure: Fiberglass NEMA 250 rated (Stahlin RJ1008HPL or approved equal) where required.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify the ITS Project Manager at least 14 calendar days before picking up the State-Furnished NID equipment to coordinate pickup location and time.

B. Load, transport, and install all State-Furnished materials per the manufacturer's instructions and as shown in the contract.

C. Deploy traffic control devices, personnel, or both. Refer to Section 01554.

3.2 INSTALL NON-INTRUSIVE DETECTOR (NID)

A. Furnish and install all 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 in the contract, and at the height and orientation specified by the NID manufacturer. Dilemma zone NID may be placed on signal mast arm.

D. Refer to the following for installation guidance:
   1. SSIG
   2. AT Series Standard Drawings
   3. SL Series Standard Drawings

E. NID Sensor Cable length less than 100 ft from mounted detector to ATMS Cabinet: Install the NID Surge Protector and 24 VDC Power supply on DIN rail mounted to the ATMS Cabinet wall. Refer to Section 13555.

F. NID Sensor Cable length greater than 100 ft from mounted detector to ATMS Cabinet:
   1. Install NID Surge Protector in NEMA 250 Enclosure between NID device and ATMS Cabinet. Mount Enclosure on pole, luminaire extension, vertical attachment, arm, or mast arm, 10 ft above ground or higher.

2. Install additional NID Surge Protector in the ATMS Cabinet with the 24 VDC Power supply.

G. Clear equipment exterior of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

3.3 INSTALL POLE

A. Refer to Section 16525, AT Series Standard Drawings, and SL Series Standard Drawings.

3.4 CABLES AND CONDUCTORS

A. Install all cables and conductors in conduit and poles per the contract.

B. Do not exceed the minimum bending radius or the maximum pulling tension recommended by the manufacturer's specifications at any time.

C. Keep cable ends sealed at all times during installation using an approved cable end cap. Do not use tape to seal the cable end. Keep cable ends sealed until connectors are installed.

D. Provide 6 ft of neatly coiled and bundled NID cable slack in all cabinets.

E. Make all NID cable connections between the NID and ATMS cabinet per the contract.

F. Arrange wiring neatly at cabinet, junction boxes, and fixtures.

3.5 TESTING AND ACCEPTANCE

A. Successfully complete the following tests:
   1. Cable and Conductor Test: Obtain current version at time of bid of the ATMS Cable and Conductor Test form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
   2. Local Field Operations Test: Obtain current newest version at time of bid of the Non-Intrusive Detector Local Field Operations Test form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences
      a. Successfully conduct the following three tests:
         1) Detector Accuracy Verification Test: Volume
         2) Detector Accuracy Verification Test: Speed
         3) Detector Accuracy Verification Test: Occupancy

b. Conduct the Local Field Operations test after the Cable and Conductor test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.

c. Verify physical construction has been completed according with the contract and that the connecting cabling has been properly installed.

d. Furnish all equipment, appliances, and labor necessary for the test.

3. Acceptance Tests: Refer to Section 13595.

END OF SECTION

SECTION 13561

ATMS POWER SERVICE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing a complete electrical power service as shown in the contract. Includes all coordination with the power service provider, wires, surge protection, rigid metal riser, weatherhead, transformer, disconnects, conduit risers and stand-off brackets, breakers, clamps, conduit, junction boxes, grounding materials, duct seal, pull wire, labor, workmanship, equipment, testing, documentation, and incidental items required for a fully operational system.

B. Materials and procedures for installing a Power Pole.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 13551: General ATMS Requirements

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. ASTM B 117: Operating Salt Spray (Fog) Apparatus

C. Electrical Utility Service Equipment Requirements Committee (EUSERC)

D. Local utility electric service requirements

E. National Electrical Manufacturers Association (NEMA) Standards

F. National Electrical Code (NEC)

G. Underwriters Laboratories (UL)

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. In accordance with Section 13551.

PART 2 PRODUCTS

2.1 GENERAL

A. Comply with NEC standards, local utility electric service requirements and standards, and Department standards for all electric service products.

B. Provide approved underground service pedestal. Service Enclosures must be NEMA 3R rated. Refer to NEMA Standards Publication 250-1997.

C. Use a safety switch as indicated in the contract.

D. Provide circuit breakers sized as specified in the contract.

E. Provide conductors as sized and numbered in the contract.

F. Provide riser and weatherhead in accordance with Department and local utility standards. Refer to SL Series Standard Drawings.

G. Provide approved blade or breaker disconnects as specified in the contract.

H. Provide Master Lock P848 Lock. Provide two keys per lock to the Engineer or disposable aluminum lock with break-off screws for all disconnects and service pedestals.

I. Pole Mount when approved by the power provider: Refer to SL Series Standard Drawings
   1. Service disconnect according to contract.
   2. Provide a manual EUSERC approved circuit closing link by-pass release meter socket.
   3. Unmetered street lighting circuit.

J. Underground Service Pedestal: As specified, ASTM B 117, and AASHTO M 111 (Cabinet), UL E 50076.
   1. Enclosure: 0.120 inch galvanized steel or anodized aluminum
      a. 0.080 inch galvanized steel or anodized aluminum covers
      b. Finished surface with an environmental green, baked enamel over zinc-chromate primer as specified, or anodized aluminum: ASTM B 117
      c. Bottom access opening
      d. EUSERC approved circuit-closing by-pass release meter socket
      e. Baffled ventilation louvers

K. Circuit Breaker: Main Breaker
   1. Six space metered
   2. Six space unmetered bus

L. Detachable, pad-mount base.

M. Use copper conductor with stamped “RHH-USE-RHW” or “XHHW” rated insulation for all underground and riser electrical conductors.

2.2 WOOD POWER POLE

A. Comply with local utility electric service requirements in selecting power pole.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with NEC standards, local utility electric service requirements and standards, and Department standards for all electric service installations.

B. Install underground service pedestal.

C. Coordinate any utility connection with the Engineer and utility company. Contact the Engineer and utility company at least 60 days before the desired connection date.

D. Verify the exact location, voltage, procedure, and materials required by the utility company.

E. Ground all electrical equipment, including cabinets, metal structures, in accordance with the NEC standards.

F. Supply all conduit and conductors to power source connection location. The power company makes the final connection.

3.2 POWER SERVICE

A. Contact the Engineer at least six weeks before power service hookup to coordinate power service connection and to confirm connection date.

B. The Department is responsible for all on-going electrical costs.

3.3 WOOD POWER POLE

A. Install power pole as specified in the contract and in accordance with all Department and local utility standards. Contact the power company ten days before pole installation.

B. Install wood pole below grade to a minimum depth equal to one-sixth the total pole height.

C. Increase the installation depth by one pole diameter. Measure depth from the down-slope side of the pole when wood pole is installed on a slope of 2:1 or greater.

D. Backfill with native material in 1 ft lifts to match surrounding grade. Tamp each lift to at least 90 percent compaction. Refer to Section 02056 requirements for poles placed near structures.

END OF SECTION

SECTION 13591

TRAFFIC MONITORING DETECTOR LOOP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish, install, and test detector loop and detector cable.

B. Connect detector loop to control cabinet and provide complete functioning detection capability for loops.

1.2 RELATED SECTIONS

A. Section 02892: Traffic Signal

B. Section 13551: General ATMS Requirements

C. Section 13553: ATMS Conduit

D. Section 13554: Polymer Concrete Junction Box

E. Section 13555: ATMS Cabinet

1.3 REFERENCES

A. International Municipal Signal Association (IMSA)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Certified test report of detector lead-in cable compliance as specified. IMSA 50-2.

B. Samples of materials for approval when requested.

C. Provide the following submittals as described in Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Manufacturer's Equipment Documentation

PART 2 PRODUCTS

2.1 MATERIALS

A. Follow Section 02892.

PART 3 EXECUTION

3.1 PREPARATION

A. The number of loops and the number of lanes varies based on location shown in the contract.

3.2 SAW CUT

A. Maximize the area and width of any pavement sections that are created by the saw cuts.

B. Do not saw cut across a transverse joint in the traveled way.

C. Saw cut is allowed across a transverse joint in a shoulder slab. To maximize the pavement slabs created, position the cut approximately halfway along the joint.

D. Minimum distance between saw-cut and transverse joints or between adjacent lead-in saw cuts: 1½ ft.

E. Loop Spacing: 21½ ft between leading edges.
Maximum tolerance: 1 inch.

F. Do not install loops in cracked or spalled pavement.

G. Use wet vacuum or appropriate remediation to prevent saw-cutting water and residue from flowing into live traffic lanes.

H. Shape: Refer to SL series Standard Drawings.

3.3 LOOP WIRE AND LEAD-IN CABLE INSTALLATION

A. Follow Section 02892.

B. Loops: 4 turns per loop, placed counter clockwise, center all loops in lane.

C. Use blunt wood sticks to push wire into saw cut. Do not use metal tools.

D. Tag each loop within the junction box at the termination of the loop wire and within the cabinet at the termination of the detector loop cable (DLC).

E. Seal loop wire ends immediately upon installation with waterproof coating, coil neatly, and place in a junction box.

F. Install Loop Sealant
   1. Fill and encapsulate loop and lead-in wires a minimum depth of 3 inches from the pavement surface.
   2. Install embedding loop sealant in saw cuts allowing ± ¼ inch from the top of the pavement after curing and expansion is complete.
   3. Allow sealant adequate time to cure under ambient environmental conditions before lane is re-opened to traffic.
   4. Refer to manufacturer's specifications regarding expansion of sealant during curing period. Refer to Section 02892.

G. Install detector lead-in cable to from loop wire to cabinet. Refer to Section 13555. Connect cable to input file in cabinet to make loop detection fully functional at cabinet controller location.

H. Maximum detector lead in cable length allowed: 660 ft.

I. Concrete Pavement Exit
   1. Drill 2-inch diameter hole at 45-degree angle 1 ft from concrete edge.
   2. Install conduit originating from splicing junction box to the pavement edge. Extend conduit 3 inches into drilled hole.
   3. Seal conduit after loop wires are installed and fill the hole to within 1½ inches of road surface with silica sand.
   4. Seal remaining hole in the road surface with loop sealant.

J. Conduit Connection to Junction Box
   1. Seal conduit with waterproof bushings. Refer to Section 13553.
   2. Fill voids resulting from entrance of conduit into junction box with hydraulic cement grout. Refer to Section 13554.

K. Splicing in junction box
   1. Do not allow splices between the loop wire and controller cabinet.
   2. Splice only the transition from the loop wire to the detector lead-in cable.
   3. Carry the shield over the splice.
   4. Splice detector lead-in cable to loop wire in junction box with approved splice encapsulation kit.

3.4 TESTING AND ACCEPTANCE

A. Perform a Detector Loop Inductance & Resistance Test as described in Section 02892. Use current version at time of bid of the Detector Loop Inductance & Resistance Test form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences. Submit Detector Loop Inductance & Resistance Test to the Engineer for acceptance.

B. Perform the Local Field Operations Test after all Traffic Monitoring Detector Loop elements, equipment and hardware, power supply, and connecting cabling have been installed.
   1. Perform testing after all construction for the site has been completed and the final road surface has been constructed.
      a. It is not necessary for the communications installation to be completed at the time of testing.
      b. It is not necessary that all stations be tested concurrently.

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
   1. Install buried conduit in accordance with industry standards.
   2. Install junction boxes with grounding rods, tower foundation, and fencing as specified in the contract or as directed by a UDOT representative.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork

C. Section 02821: Chain Link Fencing and Gates

D. Section 03055: Portland Cement Concrete

E. Section 03211: Reinforcing Steel and Welded Wire

F. Section 03310: Structural Concrete

G. Section 13553: ATMS Conduit

H. Section 13554: Polymer Concrete Junction Box

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

A. Provide a preliminary installation schedule to the Engineer 30 days before the start of work.

PART 2 PRODUCTS

2.1 POWER

A. Use electrical components as listed and defined by the National Electrical Code (NEC).

B. Supply conduit per Section 13553, junction boxes per Section 13554, and ground rods per Section 13554 and NEC 250.

C. Use 4-inch schedule 40 galvanized pole for solar power only.

2.2 REMOTE PROCESSING UNIT (RPU) TOWER FOUNDATION AND SERVICE PAD

A. Refer to Section 02056 for compaction.

B. Use Class AA(AE) concrete per Section 03055

C. Use 6-6-10-10 welded wire mesh per Section 03211.

2.3 TOWER GROUNDING SYSTEM

A. Wire: State-Furnished 32 strand, #210 weight, $^{7}/_{16}$-inch tinned copper ground cable. Refer to AT Series Standard Drawings and NEC 250.

B. Ground Rod: Furnish ⅝ inch diameter 8-foot copper clad. Refer to AT Series Standard Drawings, NEC 250, and ANSI/UL 467.

2.4 ENVIRONMENTAL SENSORS, RPU, COMMUNICATION EQUIPMENT, AND RWIS TOWER

A. State-Furnished.

2.5 FENCE AND GATE

A. Furnish 7-foot high Type IV chain-link fence, with barbed wire and arm, and gate. Refer to FG and AT Series Standard Drawings, and Section 02821.

PART 3 EXECUTION

3.1 GENERAL

A. Conform to the requirements of the National Electrical Code (NEC).

B. Obtain Engineer approval for tower site location and pavement sensor placement before construction.

C. Notify the Engineer seven calendar days before desired pick-up of State-Furnished materials.

D. Pick up State-Furnished materials at the following location:

Utah Department of Transportation
Traffic Operations Center (TOC)
2060 South 2760 West
Salt Lake City, Utah 84104-4592

E. Install conduit per Section 13553, junction boxes per Section 13554, and ground rods per Section 13554 and NEC 250.

F. Install all State-Furnished materials per manufacturers' instructions.

3.2 RPU TOWER FOUNDATION AND SERVICE PAD

A. Install concrete foundation and service pad. Refer to Sections 03055 and 03211.

B. Provide all necessary grading for a flat and level site. Refer to Section 02056 if necessary.

C. Finish all surface concrete with Ordinary Surface Finish per Section 03310.

D. RPU and tower installed by the Department.

3.3 TOWER GROUNDING SYSTEM

A. Wire (Installed by the Department): Install one ground cable for each tower leg. Clamp wire to the outside ground rod 10 feet from tower leg and run to the inside ground rod (3 feet from tower leg). Clamp wire to the inside ground rod. **DO NOT cut the wire.** Run the wire across the top of the concrete pad to the corner of the RWIS tower. Attach grounding wire to the tower. Refer to Section 02776.

B. Ground Rod: Install as per AT Series Standard Drawings.

3.4 ENVIRONMENTAL SENSORS

A. Installed by the Department.

3.5 RPU

A. Installed by the Department.

3.6 COMMUNICATION EQUIPMENT

A. Installed by the Department.

3.7 RWIS TOWER

A. Install tower base only. Refer to AT Series Standard Drawings.

3.8 FENCE AND GATE

A. Install chain link fence and gate. Refer to Section 02821.

B. Install 7-foot high Type IV fence with barbed wire, arm, and gates. Refer to AT and FG Series Standard Drawings.

END OF SECTION

SECTION 13593

WEIGH IN MOTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct complete weigh in motion (WIM) site, including all labor, materials, equipment, testing, and calibration required for a complete and operational WIM site.

1.2 RELATED SECTIONS

A. Section 13551: ATMS General

B. Section 13553: ATMS Conduit

C. Section 13554: Polymer Concrete Junction Box

D. Section 13555: ATMS Cabinet

E. Section 13591 Traffic Monitoring Detector Loop

1.3 REFERENCES

A. National Electric Code (NEC)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Provide all of the following submittals as described in Section 13551:
   1. Contractor Furnished Material and Equipment Lists
   2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, Piezo Calibration, and the Thirty-Day Burn-In Test
   3. Completion Notice
   4. Manufacturer's Equipment Documentation
   5. As-Built Drawings
   6. A Compliance Certificate from the piezo manufacturer for site acceptability.

PART 2 PRODUCTS

2.1 PIEZO ELECTRIC SENSORS

A. Department Furnished:
   1. Piezo Electric Sensors as follows:
      a. Commercially-available “Brass Linguini”-style piezo electric sensor.
      b. Functional between -20 degrees F and 160 degrees F
      c. Functional in up to 95 percent humidity
      d. Manufacturer-specified operating life of three years, minimum.

B. Department provides manufacturer’s installation instructions.

C. Contact engineer for current Piezo Manufacturer contact information.

2.2 CABINET

A. Use cabinet as shown in plans and details.

B. Refer to Section 13555.

2.3 JUNCTION BOXES

A. Install junction boxes according to Section 13554.

B. Install and terminate all conduit according to Section 13553.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the requirements of the NEC.

B. Contact the Engineer thirty days prior to start of work to schedule and attend a pre-installation meeting.

C. Contact the Engineer five business days before picking up Department-furnished materials.

D. Install all Department-furnished materials following manufacturers’ instructions.

3.2 PIEZO ELECTRIC SENSORS

A. Piezo Install:
   1. Cut straight slot, ¾ inch x ¾ inch, in one pass, perpendicular to and for the full width of the traffic lane.
   2. Drill ½ inch diameter 2 inch deep holes, at approximately 45 degrees, at 3 ft spacing, along both sides of saw cut as shown on AT Series Standard Drawings.
   3. Maintain a minimum of 12 inches between saw cut and concrete joints.
   4. Clean and dry slot prior to placing piezo.

B. Lead In Wires:
   1. Saw cut ½ inch wide x 3¼ inch to 6 inch deep slot for piezo lead in wires.
   2. Cover lead in wire with at least 3 inch of approved embedded sealant.
   3. Leave a minimum of 12 inches between saw cut and concrete joints.
   4. Locate all lead ins down stream of piezo.
   5. Drill ½ inch hole at edge of roadway for cover on conduit.
   6. Use one ¾ inch schedule 40 conduit for each lead in wire outside of roadway.
   7. Use piezo lead in wire long enough to reach the data recorder prior to placing 500 ft maximum.
   8. Tag and number each lead in wire for identification.

C. Refer to AT and SL Series Standard Drawings and Section 13591 for loop detector details.

D. Install all cabling between sensors and processing unit following all manufacturers' installation instructions.

E. Piezo Calibration:
   1. Perform all calibration according to piezo manufacturer's specifications.
   2. Arrange to have a representative from the piezo manufacturer and the Engineer or the Engineer's agent present.
   3. Submit a report of the successful calibration following the format of the Test Reports described in Section 13551.

3.3 CABINET AND PROCESSING UNIT

A. Install ATMS cabinet as indicated on plans and details.

B. Refer to Section 13555.

3.4 ACCEPTANCE TESTING

A. Successfully complete the following tests:

1. Cable and Conductor Test: Obtain UDOT's newest version of the ATMS Cable and Conductor Test form from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences.
2. Local Field Operations Test: Obtain UDOT's newest version of the Weigh In Motion (WIM) Local Field Operations Test from the UDOT Web site. Refer to http://www.udot.utah.gov/go/standardsreferences.
   a. Test procedure and requirements to be provided by manufacturer.
   b. Conduct Local Field Operations test after the Cable and Conductor test has been successfully completed and the Engineer has approved the Cable and Conductor Test Report.
   c. Furnish all equipment, material, and labor necessary for the test.
   d. Conduct the test after all construction for the site has been completed and final road surface has been constructed.

END OF SECTION

SECTION 13594

FIBER OPTIC COMMUNICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing and testing fiber optic communication systems.

1.2 RELATED SECTIONS

A. Section 13551: General ATMS Requirements

B. Section 13553: ATMS Conduit

C. Section 13554: Polymer Concrete Junction Box

D. Section 13555: ATMS Cabinet

1.3 REFERENCES

A. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications

B. National Electrical Code (NEC)

C. Telcordia Guidance

D. Underwriters Laboratory (UL)

E. USDA Rural Electrification Administration (REA) Specifications

1.4 DEFINITIONS

A. OTDR: Optical Time Domain Reflectometer

B. OSP: Outside Plant

C. SMF: Single-mode fiber

1.5 SUBMITTALS

A. Provide all submittals in according to Section 13551.

B. Provide evidence of training and experience for all fiber optic staff including but not limited to installation technician, splice technicians, and test technicians.
   1. Include in the file for each technician the following:
      a. Resume listing relevant education and experience.
      b. Certificate of completion for the fiber optic training course.

C. For approval:
   1. A detailed construction and installation procedure covering all aspects for the fiber optic cable installation on this project.
   2. All materials for the fiber optic cable installation on this project.
   3. Fiber labeling setup.

D. Submit OTDR test results to the Department in a neatly bound and printed format for acceptance. Include the current calibration certificate for the OTDR being used at the front of the documentation. Electronic submittal to Engineer on floppy disk or CD is also required. All Electronic files will be compatible with Siecor OTDR 383PCW Version 1.21 or higher.

E. Submit Power Meter/Light Source Test results to the Department for acceptance. Obtain the test form from the Department Fiber Representative.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials are UL listed.

B. Provide all incidental materials including but not limited to fiber optic jumpers, cable ties, labels, and connectors.

C. All materials meet Fluid Penetration Test standards (TIA/EIA-455-82B).

2.2 FIBER OPTIC CABLE

A. Approved by the USDA Rural Electrification Administration (PE-90).

B. Outside Plant (OSP) type, armored dielectric loose tube, single-mode cable.

C. Include the manufacturer's test documentation. This documentation indicates the attenuation of each cable fiber in dB/km measured at 1310 nm and 1550 nm for single-mode.

D. Outside Plant (OSP) Single-mode.
   1. Fiber Optic Glass: Corning SMF-28E or approved equal.
   2. Gel-Free Fiber Optic Cable: Corning ALTOS Lite or approved equal.

E. Fiber optic cable must comply with Telcordia GR20-CORE and TIA/EIA-4720000-A.

F. Outer jacket labeling:
   1. The date of manufacture and the manufacturer's name.
   2. A numerical sequence at intervals no greater than 10 ft to determine the length of cable and amount of cable remaining on the reel.
   3. "UDOT Fiber Optic Cable" at an interval of no greater than 10 ft.
   4. Marking height ⅛ inch nominal.

G. Label and tag all fiber optic cables in every accessible location, 6 inches from the end plate on enclosures using Panduit MP-150-C or equivalent with the following information:
   1. Span identification provided on Department splice detail
   2. Strand count
   3. Location
   4. Type of circuit such as drop cable, distribution, and backbone
   5. Example:

      Span ID = 2674
      48 ct SMFO
      Locate ID = 3500 So Distribution
      or
      Locate ID = Drop CCTV @ Main St & Center St

2.3 FIBER OPTIC CONNECTORS

A. Follow characteristics as specified in the contract:
   1. ST – Connectors (Standard)
      a. Factory installed or field installed ST or ST compatible connectors.
      b. Ceramic ferrules and metallic connector bodies.
      c. Maximum insertion loss: 0.30 dB.
      d. Connector back reflection: greater than 35 dB.
   2. LC – Connectors (use only where approved)
      a. Factory installed prepolished or field installed camlock LC connectors.
      b. Ceramic ferrules.
      c. Maximum insertion loss: 0.30 dB.
      d. Connector back reflection: greater than 35 dB.

B. Clean all connectors with alcohol wipes and a compressed cleaning gas.

C. Furnish and install new fan-out kits to replace any existing fan-out kits that must be severed to make fiber terminations.

D. Provide 3 ft nominal fan-out kits.

2.4 TYPE A AND B FIBER OPTIC CABLE SPLICE ENCLOSURE

A. Provide splice enclosures with the following minimum characteristics:
   1. Comply with Telcordia GR-771
   2. Corrosion resistant shell
   3. Allow re-entry without replacing the cable seals
   4. Hinged splice trays to provide easy access to splices on other trays
   5. Strength member tie-off
   6. Mechanism to resist cable pull-out
   7. All required accessories to complete the splice

B. Type A:
   1. Accommodates up to 288 splices
   2. Contains 2 or more 36-count splice trays

C. Type B: For locations with up to 48 splices.
   1. Accommodates up to 48 splices
   2. Contains 2 or more 12-count splice trays

2.5 SPLICE ENCLOSURE FIBER DETAILS

A. Provide 3 ft of buffer tube slack from end plate.

B. Provide label for each buffer tube located 1 inch from the splice tray. Description on label will identify as to which fiber cable and direction cable is coming from.

C. Provide 3 to 4 ft of fiber optic strands outside of buffer tube from each cable before splicing.

PART 3 EXECUTION

3.1 INSTALLERS

A. Complete a three-day course on fiber optic cable installation, splicing, and testing.
   1. Course: conducted by the 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.

3.2 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

A. Do not perform fiber splices that are not shown in approved splice details without prior written authorization from UDOT ITS Fiber Division located at the UDOT Traffic Operation Center, 2060 South 2760 West, Salt Lake City.

B. Splice all drop cables to the main fiber run with a mid span entry to the cable unless described differently in the contract.

C. Notify the Engineer five business days in advance of fiber optic cable installation into any existing conduit, ATMS site, or building facility.

D. The Engineer may initiate special inspection procedures to verify the condition of existing communications facilities. Observe inspections as desired.

E. Perform all work in facilities on conduits, junction boxes, cabinets, and buildings containing the Department's existing equipment only in the presence of the Department’s representative.
   1. Refer to Section 13553 for conduits.
   2. Refer to Section 13554 for junction boxes.
   3. Refer to Section 13555 for cabinets.

F. Restore Contractor damaged facilities within 48 hours.

G. 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)

H. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension specified by the cable manufacturer.

I. Maintain the following minimum bend radii:
1. 20 times Cable Diameter during installation.
2. 10 times Cable Diameter installed.

J. Provide the following minimum slack:
1. Junction Boxes with Splice Points: 35 ft from installed splice case to conduit on all cables.
2. Type III Polymer Concrete Junction Boxes without Splice Points: 80 ft.
3. Type II Polymer Concrete Junction Boxes, except at cabinet apron: 30 ft.
4. Type II Polymer Concrete Junction Boxes located on the cabinet apron: 15 ft.
5. Fiber optic tail for installed 3 ft fan-out kit: the measured height of the cabinet.
6. All other junction boxes: 15 ft.

K. The Department will not pay for additional slack provided in excess of the minimum specified.

L. Replace any fiber optic cable segment not meeting the requirements of the specifications in its entirety between full splice points.

3.3 FIBER OPTIC CABLE PREPARATION

A. 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.

3.4 ENTRY AND REENTRY OF FIBER OPTIC SPLICE ENCLOSURES

A. Perform all work in an environmentally controlled atmosphere. Acceptable environments include office type environments in buildings, splice trailers, and splicing tents with floors. Do not splice, test, connect, or open fiber ends in locations with freezing temperatures, rain, snow, or wind-blown dust.

3.5 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 or organizers.
   4. Use glass capillaries, heat shrink tubing, or silicone sealant to provide additional protection and strain relief.
   5. Comply with maximum splice loss allowance of 0.05 dB.

C. Install new splice enclosure end plates according to manufacturer's recommendations at each location where there is a new fusion splice in an existing splice enclosure.

3.6 SPLICE TRAY LABELING REQUIREMENTS

A. Label all buffer tubes with tags that include device type such as CCTV, VMS, or TMS.

B. Label distribution buffer tubes with tags marked "Distribution" and include direction of path such as westbound or eastbound.

3.7 ACCEPTANCE TESTING

A. Contact the Engineer five business days before performing all acceptance testing (Post Termination and Splicing OTDR and Power Meter).

B. Perform all fiber optic testing with an OTDR capable of producing output files compatible with the Siecor OTDR 383PCW Version 1.21 or higher.

C. OTDR Testing Requirements:

1. Test every fiber strand passing through any open splice tray after completing the required work.
2. Conduct all traces with a pigtail or fiber box between the OTDR and the fiber under test. Use pigtail of sufficient length to show the connector or the start of the strand under test.
3. Do not exceed launch transition of 0.6 dB.
4. Conduct all traces at both 1310 nm and 1550 nm.
5. Uni-directional traces are acceptable unless otherwise noted.
6. Provide traces with the following information:
   a. Horizontal Axis: Distance in feet and kilometers.
   b. Vertical Axis: Attenuation scale in dB.
   c. Traces showing attenuation versus distance.
   d. Cursors positioned at cable ends.
7. 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.
8. Provide an event table showing all events having more than 0.05 dB loss containing event type, position from OTDR end, loss, and reflectance.
9. The maximum total allowable attenuation is 1.0 dB for cables less than 3300 ft (1 km) in length.
10. Identify fibers by strand number.
11. Submit results in printed form on 8½ inch x 11 inch paper in a suitable binder organized by cable and strand number.
12. A cover sheet is required for each binder indicating which cables were tested, OTDR user's name, reviewer's name, test type performed, and the test date.
13. 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.
14. 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 resplice for intermediate test results.
15. Submit to the Engineer on digital media with a printed index.

D. Post Installation/Pre-Splicing Test:

1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage, excessive pulling tension, and kinks exist or when any damaged strand is found.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Uni-directional.

4. Location of test: One field location for each cable installed.
5. Test after installing cable in duct but before splicing.
6. Tested by: Qualified Staff.
7. Witnessed/Approved by: Department inspector may witness and must approve before splicing.
8. Acceptance Criteria:
   a. Cable attenuation 0.4 dB/km at 1310 nm.
   b. Cable attenuation 0.25 dB/km at 1550 nm.
   c. Strand lengths are consistent.
   d. Launch Transition < 0.6 dB.
   e. No event > 0.10 dB.
9. Trace available for one strand in every buffer tube in the cable.

E. Post Termination and Splicing Test:
1. Test every strand in all cable segments including connectorized strands of drop cables.
2. Light Frequency: 1310 nm and 1550 nm.
3. Direction: Unidirectional.
4. Location of test: Every field location required to obtain access to each cable segment.
5. Test after terminating and splicing at all points described in the contract.
6. Cable Tested by: Certified Staff.
7. Department inspector witnesses and approves before final approval by the Engineer.
8. Acceptance Criteria:
   a. Cable attenuation 0.4 dB/km at 1310 nm excluding splices described in the contract or authorized by the Engineer.
   b. Cable attenuation 0.25 dB/km at 1550 nm excluding splices described in the contract or authorized by the Engineer.
   c. Strand lengths are consistent.
   d. Launch Transition < 0.6 dB.
   e. No event > 0.30 dB.
   f. Maximum splice attenuation 0.05 dB per splice unless otherwise described in the contract.
9. Trace available for each strand in all cable segments.

F. Power Meter/Light Test:
1. 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 Resident Engineer or Department Fiber Representative at the pre-construction meeting. Connect a power meter to the other end of the fiber at the location identified on the test form. Record the results and submit the completed form to the Engineer.

2. Use the light frequencies of 1310 nm and 1550 nm or as indicated in test forms.
3. Perform the test bi-directional.
4. Test every field location required to obtain access to each cable segment.
5. Perform all testing using a qualified staff member.
6. A Department inspector witnesses and approves the results before final approval by the Engineer.
7. Acceptance Criteria:
   a. Cable attenuation as called for in test plans.
   b. Test is available for each strand indicated in test plans. Otherwise, test will be available for each strand in each cable segment.

G. All work to conform to the NEC.

END OF SECTION

SECTION 13595

ATMS INTEGRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Integration of all appropriate ATMS devices, including successful completion and documentation of all field operational tests.

B. Install and connect all incidental equipment as required for a complete and operational system.

C. Furnish all necessary test materials, cables, connectors to complete and test the integration of the ATMS device.

1.2 RELATED SECTIONS

A. Section 13551: General ATMS Requirements

1.3 REFERENCES **Not Used**

1.4 DEFINITIONS **Not Used**

1.5 SUBMITTALS

A. In accordance with Section 13551.

B. Test report for the 30 Day ATMS Burn-In Test.

PART 2 PRODUCTS **Not Used**

PART 3 EXECUTION

3.1 ACCEPTANCE TESTING

A. Provide a Completion Notice per Section 13551 once Local Field Operations Tests have been successfully completed on all devices. Notify the Engineer in writing of readiness to begin integration.

B. Integration requires the successful completion of a 30 Day ATMS Burn-In Test, consisting of the verification of valid data and control at the communications demarcation point for all devices. Obtain a new version of the UDOT 30 Day ATMS Burn-in Test Report form from the UDOT Web site at time of bid. Refer to http://www.udot.utah.gov/go/standardsreferences.

C. Notify the Engineer in writing at least five working days before the proposed date that the Acceptance Tests will take place. Obtain a new version of the UDOT ATMS Testing Pre-Notification form from the UDOT Web site at time of bid. Refer to http://www.udot.utah.gov/go/standardsreferences. The Engineer must witness the Acceptance Tests or designate an individual or entity to witness the Acceptance Test on the Department's behalf.

D. The Engineer may grant Partial Acceptance of the project once the Local Field Operations Test has been successfully completed on all sites. The 30 Day ATMS Burn-In period begins at this time. Begin the 30 Day ATMS Burn-In period for all ATMS devices of the same type on the same day.

E. Operate the device, in coordination with Traffic Operations Center (TOC) staff, on a daily basis during the 30 Day ATMS Burn-In period noting the results on the 30 Day ATMS Burn-in test form. The Department TOC staff may help verify the daily equipment operation if at the time of testing, communications are consistently provided from the site to the TOC.

F. Promptly remedy the defect in the event of a failure due to equipment or workmanship.
   1. Provide the Engineer with a Completion Notice.
   2. Restart the 30 Day Burn-In period for that device from day one.
   3. The Engineer may identify an independent third party to specify what defects must be addressed for the work to meet the specifications in the event of a second failure at the same device. Cover the costs required to remedy the defect if defects are identified.
   4. The Engineer may authorize others to complete the work at no additional cost to the Department if the Contractor fails to remedy any identified deficiencies in the work within the time required by the Engineer.

G. Engineer grants Final Acceptance after the 30 Day Burn-In period is complete and all required documentation has been received.

END OF SECTION

SECTION 16135

ELECTRICAL JUNCTION BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical junction boxes and extensions, including maintenance markers.

1.2 RELATED SECTIONS

A. Section 02056: Embankment, Borrow, and Backfill

B. Section 02842: Delineators

1.3 REFERENCES

A. AASHTO M 111: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

B. AASHTO M 183: Structural Steel. (Metric)

C. ASTM D 256: Determining the Pendulum Impact Resistance of Notched Specimens of Plastics

D. ASTM D 543: Evaluating the Resistance of Plastics to Chemical Reagents

E. ASTM D 635: Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

F. ASTM D 638: Tensile Properties of Plastic

G. ASTM D 648: Deflection Temperature of Plastics Under Flexural Load

H. ASTM D 790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

I. AWS D 1.5

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

PART 2 PRODUCTS

2.1 PLASTIC JUNCTION AND PULL BOXES

A. Plastic body and cover meeting the physical and chemical requirements listed in Table 1 and the following:
   1. All components constructed of a high density polyethylene with ultraviolet inhibitors.
   2. Non-skid surface on lid required.
   3. Vandal resistant recessed bolts.
   4. Capacity to support a 6¼ inch diameter load of 5,000 lbs with a maximum lid deflection of 1 inch.
   5. Withstand a 7,940 lb wheel load without cracking.

B. Minimum wall thickness of ¼ inch.

C. Self-extinguishing when tested by the industry standard. Refer to ASTM D 635.

D. Show no appreciable change in physical properties when exposed to the weather.

Table 1

Changes in Properties		
Properties	**ASTM Test**	**Value**
Tensile Strength	D 638	4,300 psi
Flexural Modulus	D 790	190,000 psi
Defection Temp at 66 psi	D 648	165 degrees F.
Notched Impact	D 256	0.107 Nm/mm
Effect of Acids	D 543	Very Resistant
Effect of Alkalis	D 543	Very Resistant

E. Mark the junction box lid in the logo area with 1 inch letters:
   1. “Traffic Signal” when the junction box contains traffic signal conductors with or without street lighting conductors.

2. “Street Lighting” when the junction box contains street lighting conductor only. Inscribe “High Voltage” below the words “Street Lighting” when the junction box contains voltage above 600 V.
3. “Communication” when the communication conduit is in the junction box.
4. “Sprinkler Control” when the sprinkler control conduit enters the junction box.
5. “Count Station” when the traffic count station conduit enters the junction box.

F. All ferrous metal parts: minimum chromium content of 18 percent and a minimum nickel content of 8 percent.

2.2 STEEL JUNCTION BOX

A. Provide galvanized steel junction box with welds as specified.

B. Meet requirements of:
1. AASHTO M 183
2. AWS D 1.5
3. AASHTO M 111

2.3 DUCT CAULKING

A. Junction boxes: waterproof, rodent proof, non-corrosive, non-oxidizing, and non-hardening when subject to temperatures ranging from -15 degrees F to 150 degrees F.

2.4 MAINTENANCE MARKERS

A. At junction box.

B. Steel posts: Refer to Section 02842.

2.5 BACKFILL

A. Free draining granular backfill borrow. Refer to Section 02056.

B. Granular backfill borrow. Refer to Section 02056.

PART 3 EXECUTION

3.1 INSTALLATION

A. Place the top of junction boxes flush with adjacent surface.

B. Junction box and extension:

1. Holes drilled in junction box must not be more than ¼ inch larger than conduit diameter. Seal conduit ends inside all non-metallic junction boxes with at least 2 inches thick duct caulking after wires are installed.
2. Hand tamp the granular backfill borrow material around the junction box. Match the top 4 inches to the composition, density, and elevation of the surrounding surface.

END OF SECTION

SECTION 16525

HIGHWAY LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing 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 02892: Traffic Signal

E. Section 03055: Portland Cement Concrete

F. Section 03211: Reinforcing Steel and Welded Wire

G. Section 03575: Flowable Fill

H. Section 05120: Structural Steel

I. Section 09972: Painting for Structural Steel

J. Section13554: Polymer Concrete Junction Box

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 Structures Supports for Highway Signs, Luminaires, and Traffic Signals (current edition)

D. ASTM A 36: Carbon Structural Steel

E. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

F. ASTM A 572: High-Strength Low-Alloy Columbium-Vanadium Structural Steel

G. ASTM A 595: Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use

H. ASTM B 3: Soft or Annealed Copper Wire

I. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

J. ASTM B 29: Refined Lead

K. ASTM B 766: Electrodeposited Coatings of Cadmium

L. ASTM F 1554: Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength American Iron & Steel Institute (AISI)

M. American National Standards Institute (ANSI)

N. American Wire Gauge

O. Insulated Power Cable Engineers Association (IPCEA) Standards

P. ITE/ANSI Lamp Codes

Q. National Electric Code (NEC)

R. National Electrical Manufacturers Association (NEMA)

S. National Fire Protection Association (NFPA)

T. Standard Specifications for Construction and Bridges on Federal Highway Projects

U. Underwriters Laboratories (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS

A. Supply manufactures certification upon request.

B. Wiring schematics, detailed shop drawings, and certifications within 15 calendar days after receiving the Notice to Proceed.

C. Manufacturer's warranties, guarantees, instruction sheets, and parts lists.

D. List of equipment and materials including name of manufacturer, size, and identification numbers within 15 calendar days after receiving the Notice to Proceed.

1.6 QUALITY ASSURANCE

A. Electrical components must conform to the requirements of the National Electrical Code (NEC).

1.7 ACCEPTANCE

A. Lighting Warranties and Guarantee
   1. The notice of acceptance for highway lighting work is not given until six months after the date of completion of punch list items.
   2. All manufacturer's warranties and guarantees on Contractor-furnished electrical and mechanical equipment are enforced during this period.
   3. The Engineer makes written acceptance of the work completed and relieves the Contractor of further responsibility for that portion of the project at the end of the period and after all electrical and mechanical defects within the scope of warranties and guarantees are corrected.
   4. Partial acceptance does not void or alter any terms of the Contract.

B. The six-month warranty period for lighting does not affect the processing of a semi-final estimate when the Contract is 95 percent or more complete or after completion of work on the project.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wire and Cable: Refer to American Wire Gauge.

B. Conductors:
   1. Wire up to 600 V: Single-conductor, copper cable with cross-link polyethylene insulation according to ASTM B 3 and B 8, RHH-USE-RHW.
   2. Cable above 600 V: Conform to NEMA WC7. Single-conductor, stranded copper with full concentric neutral.

C. Ground wire: Bare, soft-drawn copper wire according to NEC 250-1.

D. Ground Rod: Copper-coated steel according to ANSI/UL 467.

E. Insulation: RHH-USE-RHW grade crosslink polyethylene compound.

F. Splicing: Compression splice compatible with individual cable insulation and water seal for underground use. Comply with current UL code.

G. Conduit: as indicated.
   1. Schedule 40 PVC and 80 PVC conduit and fittings rated at 200 degrees F as specified. NEMA TC-2/TC-3 UL.
   2. Galvanized rigid steel conduit and fittings as specified. Meet ANSI C 80.

2.2 JUNCTION BOXES

A. Refer to Section13554.

2.3 POWER CABLE ROUTE MARKER

A. Meet 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.

2.4 SPLICE, MOLDED CONNECTOR, AND FUSE HOLDER

A. Use individually insulated and water sealed compression splice.

B. Use spring-loaded, molded connector and fuse holder with 90 percent minimum conductivity according to ANSI/UL 486A.

2.5 FUSE

A. 600 V current limiting with 200,000 A interrupting rating. Refer to UL Class CC.

B. Light pole fuses with rating according to Table 1.

Table 1

Light Pole Fuses		
Voltage	**Wattage**	**Current (Amps)**
120	250/400	20
208/240	250/400	15
277/480	250/400	10

C. Lighting Circuit Fuses: Refer to UL Class RK5.

D. 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 ft^2.
3. Maximum allowable deflection of 4¾ inch. Deflection criteria is 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:

E = east	C = collector
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. Foundation:
   1. Concrete: AA(AE). Refer to Section 03055.
   2. Coated reinforcing steel. Refer to Section 03211.
   3. Anchor bolts: Galvanized steel. Refer to AASHTO M 232 and ASTM F 1554, grade 55.
   4. Drilled Shafts: Refer to Section 02466.

2.7 POLE – MOUNTING HEIGHT UNDER 45 FEET

A. Allowable stresses for steel as specified in current AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Refer to ASTM A 572 and ASTM A 595 minimum yield 55 ksi. Meet Fatigue Category II.

B. Breakaway base: Refer to SL Series Standard Drawings.

C. Steel Base Plate: Type NS, ASTM A 572 or ASTM A 595 minimum yield 55 ksi.

D. Anchor bolts: Refer to AASHTO M 232 and ASTM F 1554, grade 55.

E. Slip bolts:
   1. Cadmium-plated Type NS
   2. Nuts and washers

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. Refer to ASTM A 572 Grade 50. Meet Fatigue Category I for poles over 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. Head frame: zinc, electroplated with yellow chromatic dip after fabrication and a head frame cover of spun aluminum and with six each 5 inches cast aluminum hoist cable sheaves with oil-impregnated, sintered-bronze bushings with stainless steel shaft.
   2. Support cables: three each stainless steel ¼ inch, 7 x 19 aircraft cables (minimum $^{3}/_{16}$ inch).
   3. Luminaire support ring: minimum 10-gauge galvanized steel, rising rate of at least 12 ft/min.
   4. Power cable sheaves: 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.
   7. Internal drive motor: UL Listed as heavy duty, reversing, with torque limiter.

2.9 LUMINAIRE

A. Highway luminaire: Die cast aluminum top housing, pre-wired integral ballasts with quick disconnect plugs mounted for ease of removal.
   1. Reflectors, sockets, mounting cradles, and clamps fitted to upper housing.

2. Optical assembly: formed aluminum reflectors with a chemically bonded, non-breakable, glass finish.
3. Adjustable mogul base sockets: NEMA E39, nickel plated brass, lamp grips, cantilevered, spring-loaded, center contacts, and heat- and impact-resistant glass prismatic refractors.
4. Weight: No more than 77 lb with a projected area of not more than 3 ft^2.
5. Mounting adjustment: Not less than 10 degrees above a horizontal position on reflector and refractor and not less than 3 degrees of adjustment from a vertical position on the bracket arm.
6. Glare shields: Steel or aluminum when indicated on the plans.

B. High mast luminaire: UL 1572.
1. Symmetrical or asymmetrical with the asymmetrical capable of a 360 degrees rotation.
2. Cast aluminum ballast, slipfitter mounts with adjustment of at least 3 degrees.
3. Optical assembly: Open, ventilated, treated aluminum reflector.

C. Understructure luminaire: NEMA FA1-1973R1979.
1. Specifically designed for understructure application.
2. Die-cast aluminum housing, vandal-proof fastener, integral ballast.
3. Optical assembly: heat- and impact-resistant, tempered glass, or prismatic acrylic lens and stainless steel lens guard.
4. Wall mount: adjustable sockets for minimum 60-degree beam angle.

D. Overhead sign luminaire: NEMA FA1-1973R1979.
1. Die-cast aluminum housing, die-cast aluminum door, and integral glare shield, single piece, closed-cell gasket. Immunity to rain and snow damage.
2. 1¼ inch square conduit clamp support.
3. Photometrics designed specifically for sign illumination.
4. Integral ballast for high-pressure sodium or metal halide luminaires. Separate ballast housing for induction lamp luminaire.
5. Weight: no more than 40 lbs with a projected area of not more than 2.5 ft^2.

2.10 LUMINAIRE BALLASTS

A. Refer to ANSI C82.4, C82.6, C92.1, and ANSI/UL 1029.

B. High pressure sodium ballast.
1. Power Factor: must maintain 90 percent for nominal secondary load and a least 70 percent for any 10 percent voltage variation.
2. Lamp Wattage: maintain no more than 5 percent variation.

3. Regulation: maintain no more than 35 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 sustain lamp operation for a minimum of 4 seconds at a voltage dip of 35 percent.

C. Metal Halide Ballast.
1. Power Factor: minimum of 90 percent for a 10 percent voltage variation.
2. Lamp Wattage: no more than 5 percent variation.
3. Regulation: maintain no more than 15 percent for 10 percent line-voltage variation.
4. Must start and operate at the rated lamp wattage at ambient temperatures down to -13 degrees F for the rated life of the lamp.
5. Must sustain lamp operation for a minimum of 4 seconds at a voltage dip of 40 percent.

D. Induction Lamp Ballast
1. Power Factor: minimum of 90 percent for a 10 percent voltage variation.
2. Lamp Wattage: 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.

2.11 LAMP

A. Heavy duty, long life incandescent (I) lamp, as specified. Meet ITE/ANSI lamp codes: I, M, H, and S.

B. Phosphor-coated metal halide (H) lamp that uses or has:
1. Correlated color temperature of 3,800 K.
2. Pulse start.
3. Rated life of no less than 15,000 hours at 10 hours per start-up.

C. Clear high pressure sodium (S) lamp that uses or has:
1. Apparent color temperature of 2,100 K.
2. Non-cycling characteristics.
3. Rated life of no less than 24,000 hours at 10 hours per start-up.

D. Induction lamp that uses or has:
   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 SERVICE DISCONNECT SWITCH

A. Meet NEMA 3R K91, Type HD.

B. 100 A Service disconnect switch with padlock as specified.

C. Circuit Breaker
   1. 10,000 A interrupting rating for 240 V.
   2. 5,000 A interrupting rating for 480 V.

2.13 CONTROL EQUIPMENT

A. Photocell control units:
   1. Meet ANSI 136.10, NEMA Base.
   2. Solid state photo cells that match input voltage, minimum 1,800 V·A capacity.
   3. Crystal sensing devices with inverted turn-on and turn-off features.
   4. Fail safe in the “on” position. Turns on at 32 Lx ± 10 percent.
   5. Dedicated, inverted, control circuits with turn-off values of 19 Lx̣ 25 percent.
   6. Time delay range of 5 seconds to 10 seconds.
   7. Minimum 236 ft/lb metal oxide varistor lighting arrestors.
   8. Secondary sensor diodes and transient filters.
   9. Flame-retardant, high-impact covers, and acrylic windows with ultra-violet stabilizers.
   10. Clip voltage at 400 V.

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. Meet 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; valve type line arrester with no less than 650 V rating.

D. Enclosure:
   1. NEMA 3R Type 4. Encase in a cabinet with padlock as specified.

E. Circuit breaker UL rated at:
   1. 240 V at 10,000 A interrupting rating.
   2. 480 V at 5,000 A interrupting rating.

2.14 SUBSTATION

A. ANSI C57.12.25 and C57.27 NEMA 260 (cabinet) as specified.

B. 480 V secondary power, IOCA oil coolant, 150 degrees F temperature rise, 60 Hz frequency, ± 2½ percent voltage compensation taps.

C. Foundation: Refer to SL Series Standard Drawings.

2.15 LIGHTING POWER PEDESTAL

A. General requirements:
   1. Power pedestal with base, NEMA 3R cabinet with gasket sealed access doors fabricated of 3.0 mm (0.120 inch) minimum thickness anodized aluminum. Continuously welded exterior cabinet and door seams with smooth seams and free of any voids. Design to be bolted down to a concrete foundation or pad from the inside of the pedestal.
   2. Cabinet height 31-inches high plus or minus 3 inches.
   3. Provide service entrance, meter, and distribution compartments separated by corrosion resistant barrier. Provide compartment access doors with stainless steel piano hinges. Hinges on left as viewed facing the cabinet. Provide provision for padlock.
   4. Cabinet openings including ventilation holes designed to prevent entrance of insects such as wasps, hornets, bees, and varmints when access panel and doors are closed.
   5. Conform to UL508 Industrial Control Panel Labels for service entrance equipment requirements.
   6. Sealed windows made of shatter resistant polycarbonate for photocell operation. Provide two windows and mounting brackets on opposite sides of the cabinet for the photocell. Locate the windows on the sides of the cabinet.
   7. Provide pedestal documentation permanently attached to the inside of the distribution section.
   8. Provide interior labels etched or engraved and mechanically fastened to the cabinet. Adhesives are not acceptable. Label front exterior of the cabinet “UDOT LIGHTING DISCONNECT.”

B. Electrical requirements:
   1. Rated for 200-amp, 1-phase, 3-wire, 120/240V or 240/480V service.
      a. 200-amp utility landing lugs to accommodate up to 250 MCM wire.
      b. Main breaker 200-amp, 2-pole.
      c. 12-circuit panel-board interior.
      d. Lighting contactor electrically held, 30-amp, 10-pole.
      e. Lighting control by either photocell module or digital single channel astronomical time clock.
      f. Test switch with On-Off-Test settings.
   2. Pre-wired according to NEC and NEMA Specifications.
   3. Fully wired with UL approved copper XHHW-2 or UL approved equivalent cable bussing, fully rated.
   4. Circuit breakers UL approved, bolt-on, industrial grade, and rated for 10K AIC minimum.

2.16 CONCRETE AND ASPHALT

A. Concrete: Section 03055, Class AA(AE)

B. Hot Mix Asphalt: Section 02741

C. Flowable Fill: Section 03575

2.17 HARDWARE

A. Screws: Stainless steel

B. Nuts, bolts, and washers:
   1. Galvanized: AASHTO M 111
   2. Cadmium-plated: ASTM B 766
   3. Type NS, as specified

C. Mounting bands and buckles: stainless steel, ¾ inch wide, from 0.020 inch to 0.022 inches thick meeting AISI, Type 201.

D. Padlock: Master, No. P-848.

PART 3 EXECUTION

3.1 PREPARATION

A. Conform to the National Electrical Code (NEC).

B. Coordinate State Furnished Materials:
   1. Pick up at the Department's Central Warehouse, 4501 South 2700 West, Salt Lake City, UT. Contact the warehouse to schedule a pickup.
   2. Pick up drop shipment materials at location specified.

C. Contact power company at least 30 days before the connection date and verify the exact location, voltage, procedure, and materials required by the power company.

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.

E. Reuse materials only as specified or as approved by the Engineer.

3.2 CONSTRUCT POLE FOUNDATION

A. Refer to SL Series Standard UDOT Drawings.

B. Refer to Section 02892.

C. Refer to Section 02466.

3.3 TRENCHING AND DIRECTIONAL BORING FOR CONDUIT

A. Refer to Section 02892.

B. Conduit offset from roadway by more than 20 ft may be installed by plowing.

3.4 INSTALL CONDUIT

A. Refer to Section 02892.

3.5 INSTALL WIRING

A. Refer to Section 02892.

B. Install molded connectors on the cable so that the load side retains the fuse when it is disconnected at the cable's breakaway point.

C. Use compression or bus bar and water seal as specified. Splice according to UL Listed.

3.6 INSTALL CONDUCTOR

A. Install wiring in according to the appropriate articles of NFPA 70. Neatly arrange wiring within cabinets, junction boxes, etc.

3.7 INSTALL LUMINAIRES AND BALLASTS

A. Clean all light control surfaces, refractors, and reflectors immediately prior to installation to provide the maximum lumen output possible. 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.

3.8 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.

3.9 INSTALL SUBSTATION

A. Refer to SL Series Standard Drawings.

B. Coordinate work with local power company.

C. Locate foundation in a well-drained area.

D. Dig a trench and backfill for the primary power cable.

E. Install padlocks on doors.

3.10 PHOTO-ELECTRIC CONTROL

A. Adjust to “North Sky” position.

3.11 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. Remove old identification numbers without damage to galvanizing.

D. Torque:
   1. Anchor bolts to 11 lb/ft.
   2. Slip bolts to 8 lb/ft, release, and re-torque to 6 lb/ft.

E. Installing items on a pole:
   1. Do not drill steel pole.
   2. Use stainless steel mounting bands.

3.12 FIELD QUALITY CONTROL (ACCEPTANCE TESTS)

A. Continuity of grounding conductor to maintain 1,000 watt load at circuit ends maintaining 95 percent of supply voltage.

B. Test for grounds in each circuit.

C. Insulation resistance of supply conductor to ground not less than 40 MΩ (500 V megohm meter test).

3.13 SALVAGE

A. Remove equipment to be reused or salvaged carefully so that it remains in the condition existing prior to its removal.

B. Pole assembly remains the property of the Department. Transport to the location specified.

C. Remove luminaire, arm, and conductor.
   1. Grease and reinstall fastener.
   2. Remove foundation to a depth of 6 inches below the existing surface and backfill with local material.

3. Dispose of discarded junction box. Backfill with local material and compact to match adjacent area.

END OF SECTION

SECTION 16526

ELECTRICAL WORK BRIDGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing bridge electrical work.

1.2 RELATED SECTIONS Not Used

1.3 REFERENCES

A. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

B. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

C. ASTM A 153: Zinc Coating (Hot-Dip) on Iron and Steel Hardware

D. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

E. ASTM B 766: Electrodeposited Coatings of Cadmium

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratory (UL)

1.4 DEFINITIONS Not Used

1.5 SUBMITTALS Not Used

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. ASTM A 307
   2. Hot-dip galvanize after fabrication. ASTM A 153

B. Other Bolts and Anchors:
   1. ASTM A 307
   2. Electro-plated cadmium. ASTM B 766

2.3 CONDUIT AND FITTINGS

A. Use schedule 40 PVC conduit and fittings rated at 190 degrees F as specified when the conduit is totally enclosed within concrete.
   1. NEMA TC-2
   2. NEMA TC-3
   3. UL Listed

B. Use galvanized rigid steel conduit and fittings as specified when the conduit is attached to the exterior surface of the structure.
   1. Manufacture from mild steel, wrought iron, or silicon-bronze with no less than 1.25 percent silicon.
   2. UL 6
   3. ASTM A 123

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. AASHTO M 55.

B. Use boxes a minimum size of 12 inch x 8 inch x 6 inch or of 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 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 LEAD-IN WIRES

A. Install all conduit segments with 10 gauge galvanized steel wire for future use as “lead-in” wire for electrical conductors.

B. Use wire 6 ft longer than the conduit segment.
   1. 3 ft coiled at the junction box.
   2. 3 ft folded back into the terminus of the conduit so it is easily accessible for future use.

PART 3 EXECUTION Not Used

END OF SECTION

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